INSTRUCTION MANUAL

TEKTRONIX LABORATORIES
COMMERCIAL TEST EQUIPMENT

TYPE RM527

Waveform Monito

MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

INSTRUCTION MANUAL

Serial Number _____

TYPE RM527 Waveform Monitor

Tektronix, Inc.
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070-296

1164

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

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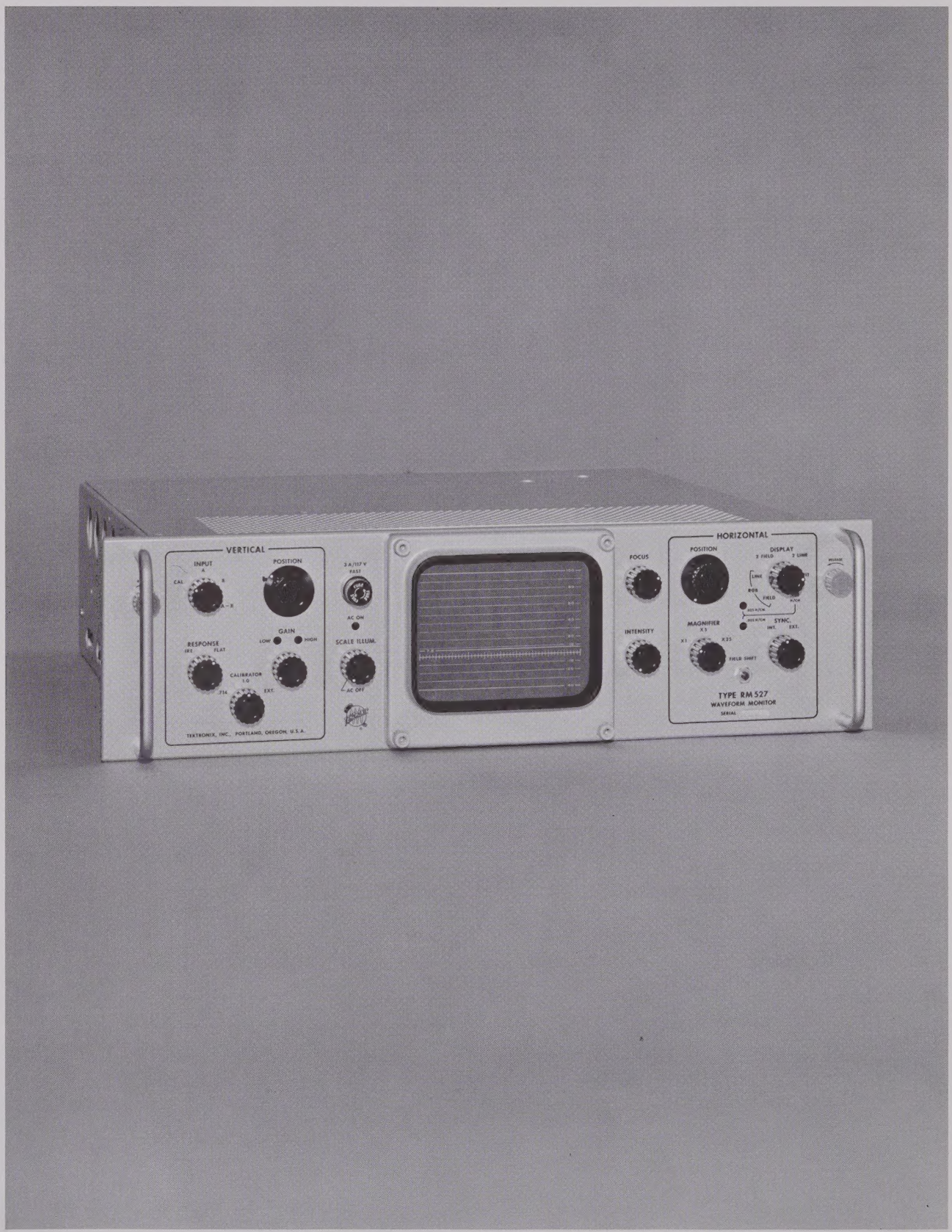
A list of abbreviations and symbols used in this manual will be found on page 6-1. Change information, if any, is located at the rear of the manual.


VERTICAL
INPUT
A
CAL.
B
A – B
POSITION
GAIN
LOW
HIGH
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IRE
FLAT
.714
CALIBRATOR
1.0
EXT.
TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.
3 A/117 V
FAST
AC ON
SCALE ILLUM.
AC OFF
FOCUS
INTENSITY
HORIZONTAL
POSITION
DISPLAY
2 FIELD
2 LINE
LINE
FIELD
MAGNIFIER
X5
X1
X25
FIELD SHIFT
SYNC.
INT.
EXT.
TYPE RM 527
WAVEFORM MONITOR
SERIAL

SECTION 1

CHARACTERISTICS

General Information

The Tektronix Type RM527 Waveform Monitor is a self-contained cathode-ray oscilloscope specifically designed for video-waveform monitoring at television transmitters and studio facilities. With this monitor, any portion of the television-signal waveform can be displayed on a 5-inch rectangular crt.

The Type RM527 vertical amplifier is provided with a network that can be switched in to limit the high-frequency response to that recommended by the IRE Standards Committee for standardized pulse-level measurements. A second switch position adds high-frequency compensation to make the frequency response flat to 5 mc, ±1%.

An internal 30-kc amplitude calibrator provides 0.714-volt or 1.0-volt pulses for calibrating the vertical amplifier. The sweep system provides calibrated sweeps which eliminate the need for time markers.

VERTICAL DEFLECTION SYSTEM

Deflection Factor

Continuously variable from 0.3 volt to 1.6 volts for 140 IRE units (7 centimeters of vertical deflection).

Frequency Response

Flat—60 cycles to 5 mc, ±1%.

IRE—1959 Standard 23S-1.

Linear Deflection

Linear within 1% on the screen.

DC Restorer

Back-porch clamping; does not affect the color-burst signal.

Signal or Video Inputs

Two bridged 75-ohm compensated signal inputs provided. Either signal input may be monitored, or a balanced (differential) input between both may be used.

Input Impedance

1 megohm paralleled by 20 pf.

HORIZONTAL DEFLECTION SYSTEM

Calibrated Sweep Rates

0.125H/CM, 0.025H/CM with ×5 Magnifier, and 0.005 H/CM with ×25 Magnifier. Accuracy in the magnifier positions is within 3% on ×5 and 5% on ×25.

Uncalibrated Sweep Rates

Half-line rate or 2 LINE (H/2) and half-field rate or 2 FIELD (V/2) for conventional displays, 1000-microsecond sweep triggered at the frame rate for VIT displays, and special line and field-rate sweeps for RGB displays.

DC Unblanking

The dc-coupled unblanking pulse permits the slowest sweeps to be used with uniform spot intensity throughout the sweep.

Horiz Input (S/N 980-up)

Connector provided for 20-cycle staircase HORIZ INPUT signal for use in conjunction with certain color-television video processing amplifiers.

CPXR (S/N 101-979)

Connector provided for 20-cycle CPXR signal for use in conjunction with certain color-television video processing amplifiers.

SYNC REQUIREMENTS

Internal

Sync obtained from vertical amplifier. Sync derived from channel A when using A-B differential input.

External

0.5-volt minimum composite video or 3.5 to 8 volts composite sync signal. Two coax connectors are provided so a 75-ohm line may be bridged or looped through the Type RM527. Inductive compensation is provided for 20-pf loading capacitance in the loop-through. Input resistance is 800 k or higher. INT-EXT SYNC switch selects either internal or external sync.

AMPLITUDE CALIBRATOR

Frequency

Approximately 30 kc.

Amplitudes

Three-position front-panel control selects either a 0.714-volt or 1.0-volt, peak-to-peak, ±1%, internal calibrator signal, or an external calibration signal (0.25 to 1.6 volts).

OTHER CHARACTERISTICS

Cathode-Ray Tube

Tektronix Type T5270-1 (T527P1) crt is normally supplied with a type 1 phosphor unless another phosphor is specifi-

cally ordered. The crt is a flat-faced 4" × 5" rectangular crt operating at 4 kilovolts accelerating potential. Calibrated viewing area is 7 by 10 centimeters. Alignment of the trace and graticule is provided by a beam rotator coil.

Standard Graticule for Composite Video Level Measurements

Illumination—Variable edge lighting.

Display Area—7 centimeters high by 10 centimeters wide.

Graticule—Scribed on back surface at every 10 IRE units; the —40, 0, +7.5 and +100 are more heavily scribed than the others. The —40 marking represents the sync-tip level, the "0" marking (marked in centimeter and 2-millimeter divisions) represents the blanking pulse level, and the +100 marking represents the maximum white level.

Other graticules for noncomposite video signals and percentage video modulation are available at slight additional cost.

Power Requirements

105 to 125 volts or 210 to 250 volts, rms, 50-60 cycles. Approximately 206 watts at 117 volts, 60 cps.

MECHANICAL CHARACTERISTICS

Ventilation

Forced-air cooling.

Finish

Photo-etched, anodized front panel.

Dimensions

Refer to dimensional drawing.

Net Weight

Approximately 34 pounds.

Accessories

1—3- to 2-wire adapter, 103-013.

2—Instruction manuals, 070-296.

SECTION 2

OPERATING INSTRUCTIONS

Cooling

A fan maintains a safe operating temperature, providing the inlet air temperature does not exceed approximately 45° C (113° F). Under no circumstances, during operation, should the air flow be restricted or obstructed.

To assure proper air circulation in the Type RM527, the top cover must be in place to direct air flow to the vertical amplifier tubes.

Oiling instructions for the fan will be found in the Maintenance section of this manual.

Radiation

To prevent high-voltage power-supply radiation of 30-kc fundamental and harmonic frequencies from affecting adjacent instruments in the rack, it is important to keep the bottom cover in place on the Type RM527.

Power Connections

The power transformer T601 is wound with two 117-volt primaries. When the instrument leaves the factory, the primaries are ordinarily connected in parallel for 105- to 125-volts, 50- to 60-cycle operation. If operation from 210- to 250-volt, 50- to 60-cycle lines is desired, remove the jumpers connecting terminals 1 and 2 and terminals 3 and 4. Then connect a jumper between terminals 2 and 3. With the line still connected to terminals 1 and 4, the instrument is ready for 210- to 250-volt operation. Fig. 2-1 shows the transformer connections required for each range of operation.

Since the fan motor remains connected across only one of the transformer primaries, no change in fan motor lead connections is required for 50- to 60-cycle operation. When the transformer connections are changed, the metal tag fastened near the power cord should be reversed and marked to indicate the new operating voltage.

For maximum dependability and long life, the line voltage applied to the instrument should be near the design center (117 or 234 volts). If the line voltage falls outside of the operating limits or has considerable distortion, unstable power supply operation may result. Observe the power line voltage and waveform with an oscilloscope before checking for other causes of unstable operation.

Fuse Requirements

When the instrument is connected for 117-volt, 60-cycle operation, use a 3-amp fast-blowing type fuse. When the instrument is connected for 234-volt, 60-cycle operation, use a 1.5-amp fast-blowing type fuse.

Installing the Type RM527

Refer to the Installation section at the rear of the manual for complete rack-mounting instructions.

FRONT-PANEL CONTROLS

Front-panel view of the Type RM527 Waveform Monitor is shown in Fig. 2-2. Functions of all front-panel controls are described below.

SCALE ILLUM	Turns the instrument power on and off, and controls graticule illumination.
FOCUS	Control to adjust the display for maximum sharpness.
INTENSITY	Control to vary the trace brightness.

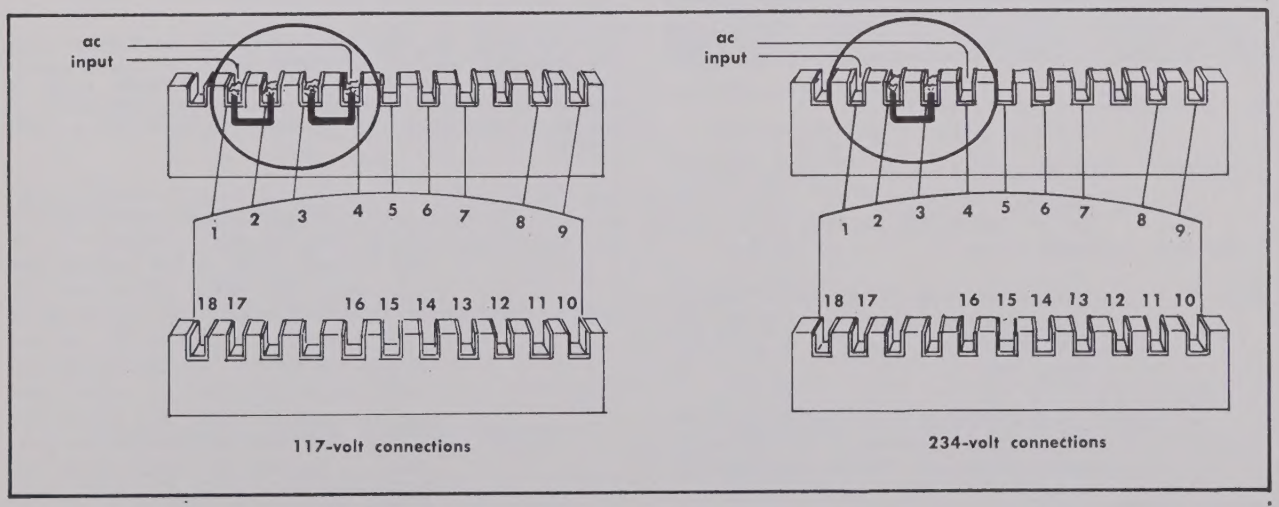


Fig. 2-1. Transformer connections for 117- and 234-volt operation.

CALIBRATOR — Three-position switch to select either a 0.714-volt or 1.0-volt peak-to-peak (±1%) internal calibrator signal, or an external calibration signal.

VERTICAL

INPUT — Four-position switch to select one of four input signals; Calibrator, A, B or A-B differential.

RESPONSE — Two-position switch to select the amplifier frequency response; IRE (3.58 mc, 90%-down) or FLAT (dc to 5 mc, ±1%).

POSITION — Control to position the trace vertically.

GAIN — Continuously variable control with a minimum range of 2.5 to 1 and a LOW-HIGH switch which can reduce the gain 2.5 times in the LOW switch position. The switch is mechanically linked to the GAIN control shaft so its operation is nearly automatic. When the switch is in the LOW position and the GAIN control is rotated fully clockwise, slight further rotation will actuate the switch. The switch is now in the HIGH position. To return the switch to the LOW position, rotate the GAIN control fully counterclockwise and actuate the switch. Neon indicator lights above the GAIN control indicate the selected switch setting.

HORIZONTAL

POSITION — A ten-turn control to position the trace horizontally.

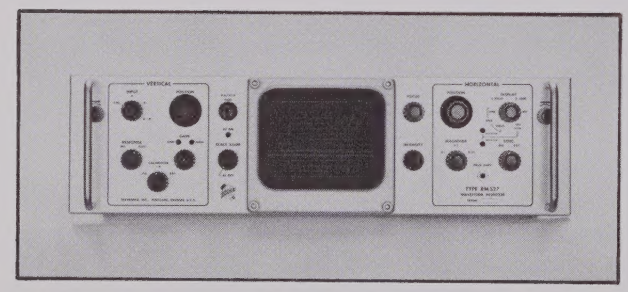
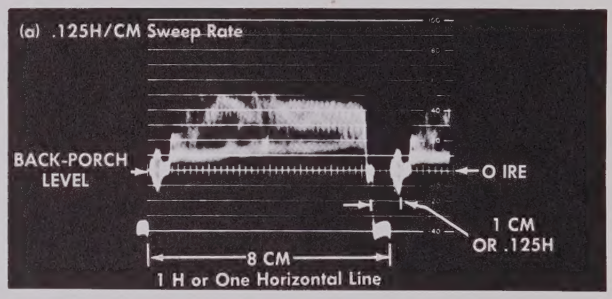


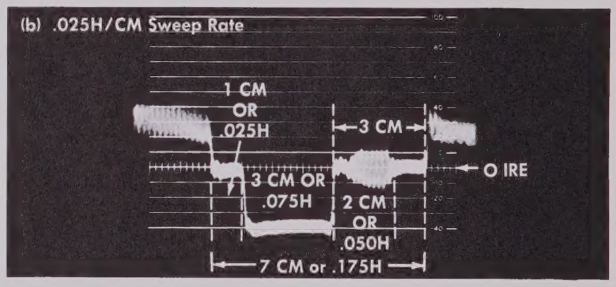
Fig. 2-2. Front-panel view of the Type RM527.

MAGNIFIER — Three-position switch to select sweep-magnification ratios of ×1, ×5 or ×25 for all except RGB positions of the DISPLAY switch.

DISPLAY — Six-position switch to select RGB field or line, 2 fields or lines of video signal, vertical interval test signal, or 0.125 H/CM sweep rate.

The 2 FIELD or 2 LINE positions of the DISPLAY switch are used for general waveform monitoring. When the DISPLAY switch is set to the 2 FIELD position the sweep operates at the frame rate, displaying approximately 1½ fields. The FIELD SHIFT button is used in conjunction with this switch position to switch between odd and even fields. When the DISPLAY switch is set to the 2 LINE position, the sweep operates at one-half television line rate, displaying approximately 1½ lines.





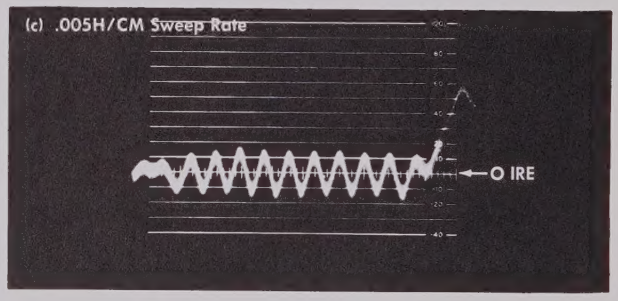


Fig. 2-3. Using the 0.125 H/CM position of the DISPLAY switch in conjunction with the MAGNIFIER switch, to make horizontal line and sync pulse measurements. (a) MAGNIFIER switch set to the X1 or 0.125 H/CM position, (b) MAGNIFIER switch set to X5 or 0.025 H/CM and (c) MAGNIFIER set to X25 or 0.005 H/CM.

In the VIT position, the sweep operates at the field rate and is triggered by the first serrated pulse in the vertical sync pulse train. The sweep rate is such that the sweep will extend past the end of the vertical blanking pulse into the first few lines of the picture. This permits excellent monitoring of details of the vertical interval test signals. With the MAGNIFIER switch set to the ×5 position, an entire three- or four-line test signal can be displayed in detail on the screen. When the MAGNIFIER switch is set to the ×25 position, any one line will fill the screen.

When the DISPLAY switch is set to the 0.125 H/CM position, horizontal sync timing is measured in terms of H (the time between horizontal sync pulses or the time from the start of one horzontal line to the start of the next line). When the MAGNIFIER switch is placed to the ×1 position, one complete horizontal line is displayed in a sweep length of 8 centimeters; see Fig. 2-3 (a). The Calibration section of the manual describes how to calibrate this sweep rate.

For pulse measurements, one centimeter equals 0.125 H. For example, in the NTSC signal specifications, 0.125 H is the maximum time interval between the leading edge of the horizontal synchronizing pulse and the end of the color burst.

When the MAGNIFIER is placed in the ×5 or ×25 position, neon lights indicate the time-base rate selected in terms of H for 0.025H/CM or 0.005H/CM pulse measurements.

The 0.025H/CM position of the MAGNIFIER switch is used, for example, for horizontal pulse measurements, as shown in Fig. 2-3 (b). The 0.005 H/CM position is useful to measure rise and fall times of sync pulses, to count the cycles of color burst (see Fig. 2-3 (c)), and to examine portions of a complete line.

In the RGB LINE and FIELD positions of the DISPLAY switch, the sweep length is reduced to three centimeters, and a 20-cycle staircase HORIZ INPUT signal of correct amplitude positions the attenuated sweep-trace length to the left during the red line or field display time, to the center during the green line or field display time, and to the right during the blue line or field display time.

The instrument does not initiate the camera switching signal. In the RGB FIELD position, the sweep operates at the field rate, not the frame rate. In the RGB line position, the sweep operates at the line rate, not one-half of the line rate as in the two-line display.

FIELD SHIFT — Pushbutton switch for selecting odd and even fields. Use this switch only when the DISPLAY switch is set to the 2 FIELD position.

SYNC* — Two-position switch to select either internal or external sync.

REAR-PANEL CABLE CONNECTIONS

Two pairs of signal input coax connectors are provided (see Fig. 2-4). These are: VIDEO INPUTS A and VIDEO INPUTS B. The video inputs are designed for high-impedance loop-through, compensated for 75-ohm systems. If it is necessary to bridge the 75-ohm line, disconnect one of the coax cables at the INPUT selector switch inside the instrument; bridging capacitance is then 47 pf.

A third pair of coax connectors, EXT NEG SYNC INPUT is provided on the rear panel for coupling external sync to the instrument. This input is a high-impedance loop-through, compensated for 75-ohm systems. No modification is required to bridge the line if bridging is necessary; bridging capacitance is 20 pf. To select external sync, place the SYNC switch in the EXT position.

A fourth pair of coax connectors, EXT CAL INPUT, located on the rear panel, is provided to couple external calibration signal to the rear of the instrument. The two connectors are in parallel to couple the signal in and out of the instrument. If a calibration signal is not coupled to these connectors, terminate the connector with a 75-ohm termination to prevent the internal calibrator signal from appearing on the screen when the calibrator switch is set to EXT.

A single connector, HORIZ INPUT (CPXR) is provided for coupling an external 20-cycle staircase signal to the instrument. When this input is not used, the connector may be terminated with a 75-ohm load to prevent stray signal pickup.

Ungrounded Input Coax Operation

Under certain installation conditions, if you notice that hum is present with the signal being monitored, you may want to unground the input coax shields to remove the hum. By "floating" the coax shield, differential operation of the instrument may be used to advantage in cancelling a common-mode signal; i.e., the same signal existing on both the inner and outer conductor of the coax.

To unground one or both coax shields in the instrument, refer to Fig. 2-5 to find the location of the grounding jumpers and where to unground them.

FIRST-TIME OPERATION

To place the instrument in operation the first time, the following procedure is suggested:

1. Connect the instrument to a source of 50- to 60-cycle, 105- to 125-volt power (or 210- to 250-volt if the power transformer is so wired).

2. Set the front-panel controls as follows:

SCALE ILLUM	AC OFF
FOCUS	Centered
INTENSITY	2/3 rotation clockwise
CALIBRATOR	.714
VERTICAL	
INPUT	CAL
RESPONSE	IRE or FLAT
POSITION	Midrange
GAIN	LOW and fully counterclockwise

*Located on rear panel of instruments S/N 101-149.

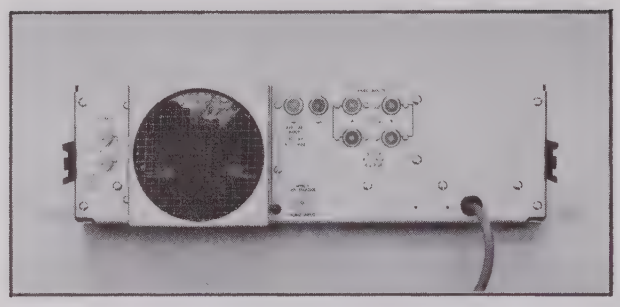


Fig. 2-4. Rear view of the Type RM527 showing rear-panel connectors.

HORIZONTAL	
POSITION	Midrange
MAGNIFIER	×1
DISPLAY	2 LINE
SYNC	INT

3. Turn the SCALE ILLUM clockwise from the AC OFF position, and let the instrument warm up for a few minutes.

4. Adjust the INTENSITY control for adequate intensity of the square-wave calibrator waveform.

5. Adjust the FOCUS control for a sharply-defined trace.

To observe other waveforms, connect a video signal to either of the VIDEO INPUTS A or B connectors and set the INPUT switch to the appropriate input.

To observe an external calibration waveform, connect the calibration signal to the EXT CAL INPUT connector and place the input switch to CAL and the CALIBRATOR switch to EXT.

Crt Beam Rotator

If the trace does not align with the horizontal graticule lines, the CRT BEAM ROTATOR (R860) needs adjusting.

To adjust this control, first set the front-panel controls the same as for first-time operation (steps 1 through 5). Then set the DISPLAY switch to VIT and adjust the CRT BEAM ROTATOR to align the closely-spaced calibrator pulses with the horizontal graticule lines.

Calibration

The internal calibrator signal is a pulse having a frequency of approximately 30 kc. Two pulse amplitudes are provided: 0.714-volt and 1.0-volt, peak-to-peak, ±1%.

When selecting 0.714-volt calibration pulses, the action of the dc-restorer circuit in the vertical amplifier holds the lower half (bottom, as viewed on the screen) of the pulses at a fixed level on the screen, determined by the VERTICAL POSITION control. This is the level at which blanking-pulse back porches are normally clamped.

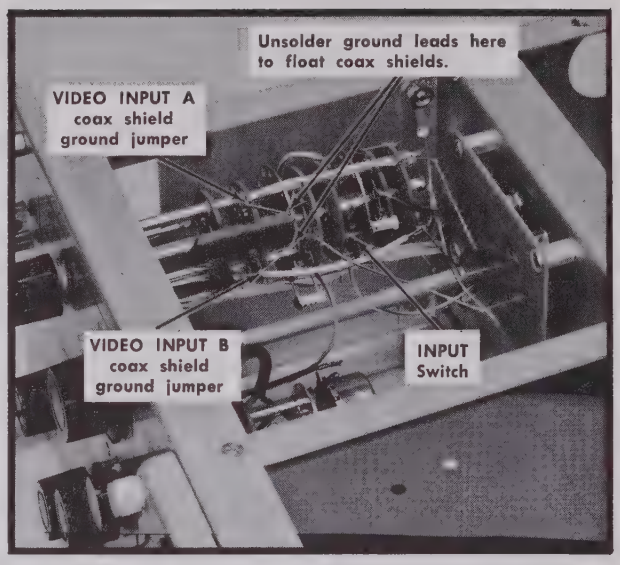

Unsolder ground leads here to float coax shields.
VIDEO INPUT A coax shield ground jumper
VIDEO INPUT B coax shield ground jumper
INPUT Switch

Fig. 2-5. Location of coax ground jumpers on the INPUT switch in the Type RM527.

To calibrate the instrument using 0.714-volt pulses, first use the VERTICAL POSITION control to set the back-porch level of the sync pulses at 0 IRE on the graticule. Then place the INPUT selector switch to CAL, the CALIBRATOR switch to 0.714, and adjust the GAIN control so the tops of the calibrator pulses are at 100 IRE units.

The 1.0-volt calibration pulses are primarily useful for calibration adjustments where a 1.4-volts video signal is to be monitored. In this case, 1.0 volt is equal to 100 IRE units. During calibration, the lower half of the 1.0-volt pulses permits the back-porch level to be set at 0 IRE on the graticule.

To calibrate the instrument using 1.0-volt calibrator pulses, set the INPUT selector switch to CAL. Set the CALIBRATOR switch to 1.0 and position the lower half of the pulses (to start) at 0 IRE on the graticule. Adjust the GAIN control so the tops of the pulses are at 100 IRE units. Set the INPUT selector switch to A or B (whichever input is used) and the back porch of the blanking pulses will clamp automatically at 0 IRE on the graticule.

When the INPUT selector switch is in the CAL position, two circuit actions occur.

1. Regardless of whether the SYNC switch is set to INT or EXT, the instrument will electronically switch to internal sync.

2. The polarity of the calibrator pulse applied to the Sync Separator Multivibrator stage is automatically inverted while the polarity of the video signal is not inverted. Therefore, the EXT CAL INPUT connector should not be used as a third video input.

External calibration pulses must be at line (15 kc) or half-line (7.5 kc) rate for proper dc-restorer action. Clipped power-line waveforms will not suffice.

SECTION 3

CIRCUIT DESCRIPTION

GENERAL DESCRIPTION

A block diagram of the Type RM527 Waveform Monitor is shown in the Parts List and Diagrams section of this manual. In general, the operation of the monitor is as follows:

An external calibration pulse, an internal calibrator pulse, or a video signal is applied to the Vertical Amplifier. The Vertical Amplifier amplifies the signal and applies it to the vertical deflection plates of the crt. The input signal is also applied to a sync separator circuit in the Sweep Trigger block. A pulse derived from the trailing edge of the separated sync pulses keys the Back Porch DC Restorer. This circuit, by means of feedback to the input amplifier, maintains the back porch of the blanking pulses, or the negative portion of the internal calibration pulses, at a fixed level on the crt. Any drift in the Vertical Amplifier is effectively eliminated by this type of dc restoration. The restorer time constant is made sufficiently long so low-frequency aberrations in the video signal; i.e., hum and tilt, can be observed.

A pulse derived from the leading edge of the separated sync signal is applied to the Sweep Generator. This pulse triggers the Sweep Generator which generates a linear sweep sawtooth and a retrace blanking pulse.

The sawtooth is applied through the Horizontal Amplifier to the crt to deflect the beam horizontally at a selected, fixed rate. Provision is also made for triggering from an external signal. The external sync signal is applied to the External Negative Sync Input connector through the SYNC switch when the switch is set to EXT.

The Calibrator provides an amplitude-calibrated pulse for use in calibrating the gain of the Vertical Amplifier. The Low-Voltage Power Supply provides regulated voltages to operate all circuits in the monitor. The crt circuits supply the regulated high voltage for the crt.

Virtually all vacuum-tube circuits in the instrument, except for diodes, have "long-tail" cathode circuits. That is, the cathode resistor is returned to a voltage well below the grid level. This configuration sets the cathode current, and therefore stabilizes the gain of the stage. This arrangement also permits the amplifiers to handle large signals.

In the remaining portion of this section, a more detailed description of the operation of each of the circuits is presented. Throughout this discussion, you should refer to the block and circuit diagrams contained in the Parts List and Diagrams section of this manual.

VERTICAL AMPLIFIER

The Vertical Amplifier contains separate Input Cathode Followers (V413A and V413B), a two-stage, push-pull Input Amplifier (V424-V524 and V444-V544) and a wide-band, push-pull Output Amplifier (V464-V564) including a cathode-follower Driver stage (V453A-V453B). All amplifier stages operate as differential amplifiers for common-mode signals.

In addition, circuits are provided to dc-stabilize and back-porch clamp the displayed waveform. These circuits are: the Back Porch and Vertical Position Comparator (V484 and V572C), Four-Diode Gate V572 (A and B) and V582 (A and B), DC Restorer Cathode Follower (V582C), and Back Porch Gate Multivibrator (V595). The additional circuitry clamps the back porch of the video blanking pulses so they remain fixed normally at the 0 IRE level on the graticule, depending on the setting on the VERTICAL POSITION control. The VERTICAL POSITION control is used to set the clamp level as desired with respect to the graticule scale.

Except for differential operation, signals from both the A and B VIDEO INPUTS are applied to cathode follower V413A. The grid circuit of the other cathode follower, V413B, is grounded in the A and B positions of the INPUT switch. In the A-B position of the INPUT switch, the circuits are arranged for differential rejection of common-mode signals. In this mode, V413A receives its signal only from the A VIDEO INPUTS, and V413B receives its signal from the B VIDEO INPUTS.

The maximum overall push-pull gain of the Vertical Amplifier is on the order of 450. This produces the required 140 IRE units of deflection (7 centimeters at approximately 16 volts/cm) at the crt with an input signal of 0.25 volt.

Input Cathode Follower. Signals to be displayed are applied through the A or B position of the INPUT selector switch SW404, and the GAIN switch SW405, to the grid of the Input Cathode Follower V413A. In the LOW gain setting of SW405, neon bulb B406 lights to indicate the selected setting. The signal is attenuated 2.5 times by an RC divider consisting of R406, C406, and R407. When SW405 is set to the HIGH gain setting, neon bulb B405 lights, R406 and C406 are bypassed, and the signal is applied to the grid of V413A without attenuation. C408 and R408 prevent excessive grid current in the event a high positive transient is applied to the input.

Input Cathode Follower V413A is a long-tailed cathode follower; i.e., cathode resistor R412 returns to a voltage well below the grid level. This arrangement permits the handling of large input signals and stabilizes the gain just below unity. The cathode signal is ac-coupled to the grid of Amplifier tube V424.

The operation of V413B is the same as that of V413A, except that it receives its input signal only from the B VIDEO INPUTS and only during the A-B mode of operation (differential).

First Differential Amplifier. The first stage of the Input Amplifier V424-V524 amplifies the potential difference between the two grids of the stage. During differential operation, when one grid goes positive and the other goes negative with respect to ground, the output of the stage is proportional to the sum of the two signals. When both grids go positive or both go negative the output is proportional to the difference between the two signals.

Differential operation can be used to advantage, for instance, when monitoring a signal riding on hum. By ungrounding the coax shields at the points shown on the Vertical Amplifier schematic and in Fig. 2-5 of the Operating

Instructions, the hum is balanced out by common-mode rejection in the Differential Amplifier stages.

For single-ended operation, the signal is applied to the grid of V424, while the grid of V524 is held stationary. With this configuration, V424-V524 operates as a cathode-coupled paraphase amplifier, having a push-pull output proportional to the signal at the grid of V424.

The plate signals from the first amplifier stage are coupled through T inductors L421 and L521, and the RESPONSE switch SW434, to the grids of V444 and V544. The T inductors provide the necessary high-frequency compensation.

When SW434 is set to the FLAT position, the signal is coupled through series inductors L434 and L436 which increase the high-frequency response to obtain a flat response out to 5 mc. When SW434 is set to the IRE position, the signal is coupled through larger inductors, L435 and L437. These inductors, in conjunction with capacitors C435, C437 and C434, C436 (S/N 332-up) reduce the bandwidth so the response conforms with the IRE bandwidth standard for pulse measurement.

DC BAL adjustment R432 sets the dc levels of the first stage through a feedback loop so the dc level does not change as the GAIN control R427 is adjusted. The feedback loop is described later when the Back Porch and Vertical Position Comparator circuit is explained. The GAIN control adjusts the gain of the Vertical Amplifier by controlling the amount of cathode degeneration in the first stage. When the control is rotated fully clockwise (zero resistance), the cathode of V424 and V524 are strapped together and the circuit has maximum gain. When resistance is added by rotating the GAIN control counterclockwise, cathode degeneration is introduced, reducing gain. The special potentiometer R427 is frequency compensated so the response does not vary as the GAIN control is adjusted.

Second Differential Amplifier. The signal applied to the second stage of the Input Amplifier, V444-V544, is amplified and coupled through T inductors L442 and L542 to the grids of cathode follower V453. The inductors provide additional high-frequency peaking for extended bandwidth.

Diodes D444 and D446 in the cathode circuit operate in conjunction with R445 to improve amplitude linearity in this stage. When large signals are applied, the diodes conduct and shunt R445. This decreases the cathode degeneration for large signals. The increased large-signal gain counteracts compression in the amplifier stages.

Output Amplifier. Cathode Follower V453 presents minimum capacitive loading to the plate circuit of the preceding stage and provides a low-impedance source to drive the capacitance of the Output Amplifier V464-V564.

The signals at the grids of the Output Amplifier are amplified by this stage and coupled through L462 and L562 to the vertical deflection plates of the crt.

Back Porch and Vertical Position Comparator. The Back Porch and Vertical Position Comparator (called the Comparator stage) are composed of V484, V572C, and associated circuitry. The Comparator stage is part of a dc feedback path for the purpose of back-porch clamping the signal at 0 IRE on the graticule, once the signal is positioned at that point with the VERTICAL POSITION control R474. The complete feedback path can be traced as follows: from the grid of V424 to the cathodes of the Output Amplifier, through V484, V572C, V572 (A and B), V582 (A and B), V582C, and then back to the grid of V424.

The Comparator stage operates with an input signal level nearly 40 times greater than the signal level at the grid of V424. With a gain of approximately 40 obtained in the amplifier stages and a gain of 30 in the Comparator, the loop gain is about 1200 as far as the cathode of V582C. The total loop gain back to the grid of V424 is reduced from 1200 to 450 by the divider action of R413 and R414. Thus, the waveform will drift approximately 0.2% with feedback, compared to a possible 100% without feedback, as the signal varies.

The only other possible drift is that produced by the Comparator and Output Amplifier stages. This resultant drift is very small, since the Comparator stage operates at a much higher signal level than the Input Amplifier. Also, excellent correlation between cathode-to-cathode voltage and plate-to-plate voltage in the Output Amplifier is inherent in the design. This circuitry permits the Output Amplifier to be brought within the drift stabilization loop.

Vertical positioning of the trace is accomplished by comparing a voltage obtained from the VERTICAL POSITION control (R474) to a voltage obtained from one of the Output Amplifier cathodes, in the Vertical Position Comparator, V484. Comparator V484 is unable to distinguish between a change in its grid-to-grid voltage caused by a change in cathode-to-cathode voltage in V464 and V564 (a trace shift), and a change in its grid-to-grid voltage produced by an adjustment of R474. In either case, a change in V484A plate voltage causes storage capacitor C582 to charge to a new voltage, which in turn is reflected back to the grid of V424. The positioning voltage is thus transferred to the input of the amplifier via the feedback system. Note that both the positioning voltage and the video signal are applied to the same grid. This prevents common-mode drift between V424 and V524.

Introduction to the DC Restorer. All television waveform monitors have a dc restorer circuit in their vertical amplifier systems to maintain the vertical position of the waveform independent of changes in the average level of the video signal. Sync tip restorers maintain the sync tips at a fixed dc level while back-porch restorers operate to hold the blanking pulses at a constant dc level.

Dc restorers may further be classified in terms of their speed. Fast dc restorers can eliminate low-frequency disturbances on the signal such as hum, streaking, and poor low-frequency phase characteristics. Slow dc restorers operate so slowly that such disturbances are not removed, but the average back-porch or sync tip level is maintained stable. Waveform monitors require slow dc restorers to show the operator any low-frequency deficiencies in the signal.

The Tektronix Type RM527 Waveform Monitor employs a "slow" back-porch dc restorer. This dc restorer maintains blanking pulses at any desired horizontal reference on the graticule. The pulses remain at the desired reference independent of average level changes or variations in amplitude of the signal or drift in the Vertical Amplifier.

Basic Operation of the DC Restorer. The operation of the DC Restorer is best understood by first examining the dc

feedback path through the circuit. If the Four-Diode Gate composed of V572 (A and B) and V582 (A and B) were replaced with a direct connection from the cathode of V572C to the grid of V582C, a complete dc negative feedback loop would be traced as follows:

From the grid of V424, through the amplifier stages to the grids of V484, to the grid and cathode of V572C, then through the imaginary connection to the grid of V582C, and then from the cathode of V582C back to the grid of V424.

The negative feedback loop operates in the following manner. If the Amplifier tube V424 should drift so its plate went slightly more positive than that of V524, the control grid of V484A would receive a negative-going dc change. Simultaneously, the control grid of V484B would be driven slightly positive. This change in control grid voltages would cause the plate of V484A to rise. This voltage rise would then be coupled, without polarity inversion, through cathode-follower V572C and the imaginary connection to the grid of V582C, and then from the cathode of V582C through the divider to the grid of V424. The resultant rise at the grid of V424 would then force the plate back to its original level. This action will take place any time there is a dc level change from side to side in the push-pull Output Amplifier stage of the vertical amplifier. Thus drift, no matter how it is caused, will be cancelled by the action of the dc feedback loop. Such cancellation is highly effective because there is additional amplification of the error signal in V484.

Detailed Operation of the DC Restorer. With the basic feedback path understood we can now consider the action of the Four-Diode Gate, consisting of the two diode sections of V572 and V582. Plate current from pin 6 of the Back Porch Gate Multivibrator V595 flows through the four diodes and back to pin 1 of V595 when the multivibrator is triggered into its astable condition. When current flows through the diodes, a low-impedance path is established from cathode follower V572C to the grid of cathode follower V582C. The potential across storage capacitor C582 can quickly change through this low-impedance path to the voltage at the cathode of V572C. Cathode follower V572C provides the necessary low-impedance point in the circuit for charging C582.

When the Back Porch Gate Multivibrator reverts to its stable state, the Four-Diode Gate is reverse biased. The diodes prevent C582 from discharging during the stable state or between gating periods of the multivibrator. Thus, C582 retains the charge during this period. Note that during the time the multivibrator is in its stable state, the dc level at the grid of V424 is held constant by the charge on C582. Dc continuity or feedback exists through the loop only during the astable condition of the multivibrator (i.e., during gating periods).

Cathode follower V582C couples the voltages from C582 back to the grid of V424 via the dc-level shifting voltage divider, R413 and R414. The divider reduces the feedback voltage but the gain of the loop is high enough for effective feedback. Input coupling capacitor C412, in combination with the voltage divider, forms a low-pass filter having a long time constant of 0.15 second. This corresponds to a 30%-down cut off frequency of one cycle per second. The time constant determines the 30%-down point of both the vertical amplifier and the dc restorer.

Storage capacitor C582 should theoretically hold its charge indefinitely during the time the diodes are reverse biased, but leakage paths in the circuit do exist. The two most significant leakage paths are grid current and heater-to-cathode leakage in V582C. C582 is specially selected to reduce leakage within the capacitor itself.

Dc restoration of the video signal back porch is accomplished by causing the Four-Diode Gate to be driven into conduction during the back porch of all blanking pulses. The back porches are dc restored to a level determined by the setting of the VERTICAL POSITION control R474. In the Type RM527, the VERTICAL POSITION control is set so the fixed level is normally at 0 IRE on the graticule. However, the fixed level may be set anywhere on the graticule, if desired, by means of the VERTICAL POSITION control.

When monitoring a color signal, the burst does not affect back-porch clamping because C582 charges to the average level for the duration of the back porch. Also, limited frequency response in the feedback circuits reduces the amplitude of the burst signal to an ineffective level before the signal reaches the Four-Diode Gate.

Back-porch clamping, in turn, does not affect the color signal display because clamping occurs beyond the signal amplifier stages.

Back Porch Gate Multivibrator. Back Porch Gate Multivibrator V595 is a monostable or "one-shot" multivibrator which drives the Four-Diode Gate bridge into conduction for approximately 3 microseconds each time it is triggered. The 3-microsecond gate pulse is a function of the time constant of R596 and C593.

Positive-going sync pulses from the Sync Separator Multivibrator are used to trigger the Back Porch Gate Multivibrator. These sync pulses are delayed for 0.5 microsecond when passing through delay cable L34 (Sweep Trigger diagram). The delay insures that a gate pulse is not obtained until the sync pulses at the cathode of V572C have passed and the back porch is present. In addition, the delay time is sufficient for the back porch to be free of any transients which may follow the trailing edge of sync pulses. Besides providing the delay time, the delay cable serves to feed the sync pulses from one chassis to the other.

After the sync pulses pass through the delay cable, the trailing edge of every sync pulse is differentiated by C34, R590 and R591 for use in triggering the Back Porch Gate Multivibrator.

SWEEP TRIGGER

Sync Selector Switch. The SYNC switch SW7 selects the source of sync. To describe the operation of the switch and associated circuitry, the description is divided into two parts: (1) Early production instruments that have the SYNC switch mounted on the rear panel, and (2) later production instruments that have the switch mounted on the front panel.

1. Early Production Instruments. When SW7 is set to the INT position, diode D19 is shorted by the switch. The internal sync from the Internal Sync Amplifier V14 is then coupled to the Sync Amplifier V24. R3, R4, and C7 provide proper loading for the external sync pulse line. When the switch is set to the EXT position, diode D19 is back biased approximately 13 volts to block all internal sync pulses. Diode D7 is forward-current biased 70 μamps to permit external sync pulses to be coupled to V24.

2. Later Production Instruments. In later production instruments where the SYNC switch mounts on the front panel, circuit changes permit the signal paths to be remotely switched by means of diodes. The circuit operates as follows:

When SW7 is set to the INT position, diode D4 turns on. Current flows from ground through R4, D4, and R7 to the +140-volt supply. The potential at the junction of D4 and D7 is approximately +14 volts. The +14 volts back biases diode D7 to block all external sync pulses. Diode D19 is forward biased to allow internal sync pulses to pass from the Internal Sync Amplifier V14 to the Sync Amplifier V24. R4 and C4 provide proper loading for the external sync pulse line.

When SW7 is set to the EXT position, D4 and D19 turn off in all positions of the INPUT switch SW404 except the CAL position. Simultaneously, D7 turns on and external sync pulses pass through D7 to the Sync Amplifier V24. If the INPUT switch is set to the CAL position and SW7 remains at EXT, the circuit reverts to the same conditions as described for internal sync operation, that is, to block external sync pulses.

External sync pulses are attenuated 50% by the network consisting of R1 and C1 working into R7, R19, and R20. The attenuation network lowers the input capacitance and safeguards the diodes from being damaged by large transient pulses.

Internal Sync Amplifiers. Internal sync is picked off from the junction of C412 and R412 in the Vertical Amplifier. Internal sync pulses originate from the following sources (depending upon the setting of the INPUT and CALIBRATOR switches, SW404 and SW880): external calibration pulse, internal calibration pulse, video signal A or video signal B.

To permit the clamp pulse at the Four-Diode Gate to be related in time with the calibrator pulse, internal sync must be employed whenever a calibrator pulse (either external or internal) is used. This is accomplished by setting the SYNC switch to the INT position and setting SW404 and SW880 to the desired position. The polarity of the internal sync, however, must be inverted when the calibrator is used. This is accomplished by means of two diode switches, D14 and D16. When SW404 is set to the CAL position, resistor R13 provides forward-biasing current to turn on diode D14. The inverted calibrator pulse at pin 6 of V14 then passes through D14 and following components to the grid of V24. Diode D16 is back biased about 4 volts by R16 and R18.

When using VIDEO INPUTS A or B to display the video waveform, the situation is reversed. Diode D16 is forward-current biased 2 ma and D14 is back biased 4 volts. The in-phase video sync signal at pin 1 of V14 passes through D16 to V24.

Internal Sync Amplifier V14 provides push-pull outputs to diodes D14 and D16 so either polarity output is available, depending on the dc-biasing of the diodes. When one of the diodes is forward biased by the power supply, the diode behaves as a low-resistance path which is not changed significantly by the small ac signal being coupled through it to the large load resistance.

Sync Amplifier V24 provides phase inversion and sufficient voltage gain for the sync to properly drive the Sync Separator Multivibrator, V34B-V45A.

Sync Separator DC Restorer. Diode D32 (S/N 1190-up) or V35A (S/N 101-1189) restores the sync tips to ground level. The diode is forward biased by current through R13. Forward bias improves the restoration of normal amplitude sync signals.

Sync Separator Multivibrator. The Sync Separator Multivibrator, V35B-V45A, is a Schmitt multivibrator having two stable states. V35B conducts when the leading edge of a sync pulse reaches —1 volt, and V45A cuts off. V35B cuts off when the trailing edge of the sync pulse falls to approximately —2.5 volts and V45A conducts.

Fully separated and regenerated sync pulses are present at the plate of V35B. These pulses are free from noise and hum which may have been present on the original video signal. In addition, the risetime of the regenerated pulses is independent of the risetime of the original sync pulses, due to the regeneration inherent in the multivibrator circuit.

The TRIG MULTI BIAS control R39 sets the dc level at which the multivibrator switches. The control is set so the multivibrator switches states at —1 volt and approximately —2.5 volts.

Regenerated sync pulses at the plate of V35B are fed to the grid of V45A and through delay line L34 to the Back Porch Gate Multivibrator, V595.

The leading edges of the regenerated sync pulses at the plate of V45A are used to develop positive-going triggers to trigger the sweep. The sweep is triggered only by vertical sync pulses when delay line L43 is switched into the circuit by the DISPLAY switch, SW160. In alternate positions of the DISPLAY switch, the sweep may be triggered by any type of pulse normally used for synchronization.

Delay line L43 and diode D44 separate the wide serrated vertical sync pulses from the narrow equalizing and horizontal pulses. When V45A conducts, a constant current of approximately 7.2 ma causes a 15-volt drop across R43. When V45A cuts off, the plate voltage rises abruptly 7.5 volts. Energy stored in delay line L43 flows out of the line and maintains the 7.5-volt drop across R43 for 6.7 microseconds (±5%). The energy in the delay line dissipates in 6.7 microseconds and the plate of V45A rises abruptly another 7.5 volts to form a second step. V45A remains cut off until the trailing edge of the serrated sync pulse cuts off V35B and causes V45A to conduct. Diode D44 is biased so the first or initial voltage jump just brings it to cut off. The second step or delayed jump turns the diode on and the delayed positive-going trigger is fed through C44 to the Sweep-Gating Multivibrator.

Note that a trigger out of diode D44 is delayed 6.7 microseconds from the leading edge of the vertical serrated pulse. If the Sync Separator Multivibrator should revert before this delay expires, no output trigger is obtained from D44. Horizontal sync pulses and equalizing pulses revert the multivibrator before delay line L43 discharges and thus no two triggers are produced until the serrated vertical sync pulses arrive.

NOTE

Delay line L43 has a delay time of 6.7 microseconds, within a tolerance of 5%. This delay is sufficient for American NTSC color and monochrome systems, the 819-line French system, and for the CCIR system in Europe. For the British 405-line standard a longer delay line is needed. To obtain a longer line of correct length, add a second identical-length L43 line.

When delay line L43 is switched out of the circuit in the alternate positions (LINE, 2 LINE, and 0.125H/CM) of the DISPLAY switch, all sync pulses trigger the multivibrator to produce 15-volt positive pulses at the plate of V45A. Since diode D44 is biased so pulse amplitudes above 7.5 volts cause the diode to conduct, the trigger pulses are the same 7.5-volt amplitude and nearly the same risetime as those produced when the delay line is in the circuit.

SWEEP GENERATOR

The sweep generator in the instrument is a Miller run-down circuit. This circuitry generates a negative-going linear sweep sawtooth.

In the quiescent condition, V45B of the Sweep Gating Multivibrator is cut off and V145A is conducting; screen current from V145A passes through Disconnect Diode V152A and R160. The drop across R160 sets the voltage at the grid of the Miller Integrator, V161A. The quiescent level at the cathode of V161B is +180 volts.

If the grid of V161A tends to go negative, the plate of V161A rises. The cathode of V161B rises, and a portion of the rise voltage is applied to the grid of V152C. Since V152C is a cathode-follower, the cathode voltage rises. The rise at the cathode of V152C pulls up the cathode of V152A, increasing its impedance. Less screen current from V145A then flows through V152A and R160, and this action arrests the tendency for the grid of V161A to go negative. A complete dc feedback loop is provided by this circuitry to maintain the dc levels during the quiescent condition, between sweeps.

When a positive-going trigger pulse from C44 causes V45B to conduct, the Sweep Gating Multivibrator switches and V145A cuts off. V152B then clamps the screen circuit of V145A near ground, which cuts off the Disconnect Diode V152A. Deprived of screen current from V145A, the grid of the Miller tube V161A starts positive and its plate starts to drop. However, negative feedback from the cathode of V161B through the Timing Capacitor (one of the C160 capacitors) prevents the grid of the Miller tube from changing. The Timing Capacitor then charges at a constant rate through R160 which causes the cathode of V161B to run down at a linear rate from an initial +180-volt level to about +40 volts. Thus, a 140-volt sawtooth is generated.

A portion of the negative sawtooth voltage is fed back to the grid of V45B which cuts off V45B when the cathode of V161B runs down to about 40 volts. The Sweep Gating Multivibrator then switches states and V145A conducts. Screen current from V145A quickly turns on V152A and the sweep returns to its quiescent level of +180 volts. When this occurs, V152C conducts and diode V152B unclamps from ground potential. V152C then prevents any further change in the voltage at the cathode of V161B.

The crt unblanking pulse is developed at the plate of V145A and coupled to the grid of the Unblanking Cathode Follower V145B. V145B provides a fast-rise positive unblanking pulse at its cathode. The unblanking pulse is applied to an unblanking deflector electrode in the crt to drive the electrode to +66 volts.

The unblanking circuitry in the instrument acts like a dc-coupled switch. During the quiescent condition, the voltage at the cathode of V145B is approximately —60 volts, which turns the beam off. When the sweep starts, the plate of V145A is driven positive and V145B drives the crt deflector to +66 volts, which turns on the electron beam in the crt.

Proper action of the Sweep Generator depends upon correct biasing of the Sweep Gating Multivibrator. Correct biasing voltage is set by adjusting the SWP GATING MULTI BIAS control R176 so V45B is biased just below cut off with the sweep at the quiescent level. Correct bias voltage insures that a trigger will start the sweep but not permit the sweep to free run.

When the DISPLAY switch is set to the 2 FIELD position and the FIELD SHIFT switch SW178 is closed momentarily, capacitor C178 quickly discharges through the parallel path of R176, and R175 in series with R173, to the —140-volt supply, and then through R179. As C178 discharges, a 125-volt negative-going pulse is produced at the junction of R175 and R176. This pulse reverts the Sweep Gating Multivibrator before the sweep sawtooth reaches full amplitude, thus permitting the multivibrator to be triggered by the next field sync pulse.

HORIZONTAL AMPLIFIER

The sweep sawtooth from the cathode of V161B is attenuated by R320, C320, and C321, working against R321, R330, R332, C331, and C332. Variable capacitor C320 is adjusted for linear sweep start with the MAGNIFIER switch SW335 set to the ×1 position. C331 and C332 set the time constant for the ×1 MAGNIFIER switch position.

In the ×5 position of the MAGNIFIER switch, the sweep sawtooth is attenuated by R320, C320, and C321 working against R321, R330, R334, C333, and C334. C333 and C334 set the time constant for this position.

Similarly, for the ×25 position of the MAGNIFIER switch, R320, C320, and C321 work against R321, R330, and C336 to attenuate the sweep sawtooth. C336 sets the time constant for this position.

The time constants of both the ×5 and ×25 positions of the MAGNIFIER switch are adjusted to match the ×1 time constant. The HORIZONTAL POSITION control R323 varies the dc voltage at the grid of V343B to horizontally position the trace on the crt.

Neon bulbs B338 and B339 are indicator lights for the 0.025 H/CM and 0.005 H/CM sweep rates, respectively. When the DISPLAY switch is set to the 0.125 H/CM position and the MAGNIFIER switch set to ×5, neon bulb B338 lights to indicate that the sweep rate is 0.025 H/CM. When the MAGNIFIER switch is set to the ×25 position, neon bulb B339 indicates that the sweep rate is 0.005 H/CM.

The SWP/MAG REGIS control R355 adjusts the current through V343B so the junction of R353 and R354 is at approximately ground potential. The control is adjusted so the MAGNIFIER switch expands the portion of the unmagnified sweep that appears at the center of the graticule. Control R355 has the same adjustment range regardless of MAGNIFIER switch settings while the HORIZONTAL POSITION control has maximum effect when the MAGNIFIER is set to ×25.

The sawtooth is converted to a push-pull signal in the Phase Inverter V374, and amplified in the Output Amplifier

V384. The amplified sweep sawtooth is direct-coupled to the horizontal deflection plates in the crt. HORIZ GAIN control R375 is adjusted for the desired sweep length, normally 10 centimeters. Adjustment of the HORIZ GAIN control, however, affects the timing. Therefore, this control should always be adjusted before other horizontal timing adjustments are made.

The HORIZ INPUT, S/N 980-up (CPXR INPUT, S/N 101-979), is provided for use with color process amplifiers which provide a three-level, 20-cps pulse, synchronized with a three-input video switcher. The video switcher permits successive red, green, and blue line- or field-rate displays to be observed side by side on the screen. The width control provided in the color process amplifier must be adjusted to obtain a proper non-overlapping RGB display on the instrument below serial number 980. Instruments above serial number 979 provide two additional controls, RGB SEP (R349) and RGB SYM (R346), which allow the three-level, 20-cps pulse to be adjusted for a proper non-overlapping RGB display. These controls are adjusted during calibration to provide the necessary separation and symmetry of the three-level 20-cps pulse. Normally, the MAGNIFIER switch is set to the ×1 position when observing this display. Since the HORIZ INPUT is dc-coupled to the Horizontal Amplifier, good low-frequency response is obtained. A Zener diode (D347) has been added to instruments above serial number 979. This diode symmetrically limits the three-level, 20-cps pulse to ±6 volts amplitude, thus removing any waveform aberrations; i.e., tilt or noise.

When the HORIZ INPUT is not used, the input should be terminated with a 75-ohm load to prevent unwanted signal pickup from being amplified by the Horizontal Amplifier.

LOW-VOLTAGE POWER SUPPLY

Plate and filament power for the tubes and transistors in the Type RM527 Waveform Monitor is furnished by a single power transformer, T601. The primary has two equal windings which are connected in parallel for 117-volt operation, or in series for 234-volt operation.

Three main power supplies, with capacitor-input filters, furnish regulated voltages of —140, +140, and +280 volts. The +280-volt supply also has an unregulated output of about +440 volts for the crt high-voltage supply. It is unnecessary to regulate this voltage as the high-voltage supply has its own regulating circuit.

The —140-volt supply is a full-wave, bridge-type rectifier circuit. Reference voltage for the —140-volt supply is established by a gas-diode VR tube, V619. This tube, which has a constant voltage drop, establishes a fixed potential of about —55 volts at one grid of the Difference Amplifier, V626. The grid potential for the other half of the Difference Amplifier is obtained from a divider consisting of R631, R632, and R636. The setting of the —140 V adjustment, R636, determines the percentage of the total output that appears at the grid of V626B and thus determines the total voltage across the divider. When this adjustment is properly set, the output of the —140-volt supply will be exactly —140 volts.

Should the loading on the —140-volt supply tend to change, an error voltage will exist between the two grids of the Difference Amplifier. The error signal is amplified by V626, whose plate is dc-coupled to the grid of the Series Regulator, V627. The error voltage appearing at the grid of V627 will change the bias and, hence, the impedance of V627. This will allow more or less current, as required, to flow through the load to force the output voltage to its original level. Resistor R627 shunts the Series Regulator to increase the available current from the supply. C631 improves the ac gain of the feedback loop, and thus increases the response of the circuit to sudden changes in output voltage. C614B is capable of furnishing high pulse currents, when demanded by the load. This capacitor sets the time constant of the regulator circuit to prevent the circuit from oscillating.

The —140-volt supply serves as a reference for both the +140-volt and the +280-volt supplies. In the +140-volt supply, the divider R661 and R662 establishes a voltage of essentially zero at the grid of the Amplifier, V654. The exact voltage at the grid of V654 will be equal to the bias required by the tube. If the loading should tend to change the output voltage, an error voltage will appear at the grid of the amplifier. The error voltage will be amplified and will appear at the grid of the Series Regulator, V657. The cathode of V657 will follow the grid, and thus the output voltage will be returned to its established value of +140 volts. C661 improves the response of the Series Regulator circuit to sudden changes in output voltage, and R657 increases the available output current. C612B has the same function as described for C614B. Two diode rectifiers, D612, A and B, provide full-wave rectification for the +140-volt supply.

The +280-volt supply functions in the same manner as the +140-volt supply except that four diodes, D610, A and B, and D612, A and B, provide full-wave bridge-type rectification. Note that the +280-volt Series Regulator is referenced to both the —140- and +140-volt supplies. If the +280-volt supply is in regulation, both of the other supplies must also be in regulation. As mentioned previously, the +280-volt supply also provides an unregulated output of about +440 volts for the crt high-voltage supply.

For instruments S/N 151 and above, the Crt Beam Rotator circuit shown on the Power Supply schematic diagram provides a high-current source for L860. CRT BEAM ROTATOR control R860 sets the current through L860 so the trace can be aligned with the graticule lines. For an additional description of beam rotator circuits which includes circuits below S/N 151, refer to the Crt Circuit description that follows.

CRT CIRCUIT

A 30-kc Hartley oscillator circuit furnishes energy for the Calibrator and the crt. The main components of the oscillator are V800 and the primary of T801 tuned by C808 and R808.

The rectifier circuit is the half-wave type, with a capacitor-input filter. V822 normally supplies —3800 volts for the cathode, approximately —3850 volts for the grid, and —3000 volts for the focusing anode. The actual voltages at the grid and focusing anode depend upon the setting of the INTENSITY (R848) and the FOCUS (R845) controls.

In order to maintain a constant deflection sensitivity in the crt, and thereby maintain the calibration of the instrument, it is necessary that the accelerating potential remain constant. This is accomplished by comparing a "sample" of the high voltage to the regulated —140-volt supply. The error signal,

obtained from the junction of R841-R842, is amplified by V814B and applied to V814A. The output of V814A varies the screen voltage of the oscillator tube, thereby controlling the amplitude of its output.

Neon bulbs B847 and B848 maintain a constant voltage across divider resistors R847 and R848 to hold the cathode of the crt at a constant potential as the INTENSITY control is varied. When the control setting is changed, the crt beam current changes. The current change is coupled through the neons instead of through the two resistors.

Resistor R851, connected from the crt cathode to the filament, raises the potential of the filament so it is the same as the cathode. The resistor isolates the crt filament winding in the power transformer from the crt cathode.

Two unblanking deflector electrodes, connected to pins 6 and 7 of the crt, act as a dc-coupled switch to turn the beam on and off. The electrode connected to pin 6 is biased at about +66 volts; the electrode connected to pin 7 is the switching electrode. During the Sweep Generator quiescent level, the unblanking pulse from the cathode (pin 1) of V145B biases the switching electrode at approximately —60 volts, turning the beam off. When the sweep starts, the unblanking pulse rapidly drives the switching electrode to approximately +66 volts and the beam turns on. The beam remains on for the duration of the pulse, which is the same as the sweep sawtooth. At the end of the sweep the unblanking pulse drops to —60 volts, and the beam turns off.

A beam rotator coil L860 located inside the crt shield permits the trace to be rotated about an axis through the center of the screen by varying the current through the coil. CRT BEAM ROTATOR control R860 varies the current through the coil and is adjusted to align the trace parallel to the graticule lines.

Two Beam Rotator circuits are shown on the Crt Circuit and Calibrator schematic diagram. Either circuit is used in instruments below S/N 151. For the circuit used in instruments S/N 151 and up, refer to the Low Voltage Power Supply description in this section of the manual.

To align the trace with the graticule in some early production instruments below S/N 151, the Low Current Beam Rotator circuit is used. Other early production instruments reguired more current to rotate the crt beam. In these instances, the High Current Beam Rotator circuit is used. In instruments using the high-current circuit, leads to L860 must be reversed to reverse the rotation of the trace.

CALIBRATOR

The Calibrator provides a 0.714- and a 1.0-volt pulse for use in calibrating the gain of the Vertical Amplifier to equal 100 IRE units on the screen. Two amplitudes are obtained by tapping at different points on a voltage divider.

The calibrator pulse is produced in the following manner. A sine wave with an amplitude of about 4.5 volts and a frequency of approximately 30 kc, obtained from the secondary of T801, drives transistor Q874 from cutoff to saturation. When Q874 is in saturation, the collector voltage drops to zero. When Q874 cuts off, Zener diode D882 holds the collector at —6 volts, preventing the collector from increasing to about —45 volts (the voltage at the junction of R875 and R886, with Q874 and D882 disconnected). These two actions result in a low-impedance square wave where the top is formed by Q874 driven heavily into saturation and the bottom by D882 driven into its Zener region.

The CAL AMPL control, R886, provides a means of adjusting the drop across resistors R884, R882, and R880 by controlling the current through them. CALIBRATOR switch SW880 selects either the 0.714-volt or 1-volt points on the divider, or an external calibration signal.

NOTES

SECTION 4

MAINTENANCE

PREVENTIVE MAINTENANCE

Recalibration

To insure accurate measurements, check the calibration of the instrument after each 500 hours of operation or every six months if used intermittently. Complete calibration instructions are given in Section 5 of this manual.

The calibration procedure can also be helpful in localizing certain troubles in the instrument. In some cases minor troubles, not apparent during normal use, may be revealed and/or corrected by recalibration.

Visual Inspection

Every few months, the Type RM527 should be visually inspected for possible circuit defects. These defects may include such things as loose or broken connections, damaged connectors, improperly seated tubes or transistors, scorched wires or resistors, missing tube shields, and broken terminal strips. For most visual troubles the remedy is apparent; however, particular care must be taken when heat-damaged components are detected. Overheating of parts is often the result of other less apparent defects in the circuit. It is essential to determine the cause of overheating before replacing heat-damaged parts in order to prevent further damage.

Cleaning

The Type RM527 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides a conduction path for electricity. Excessive dirt on the air screen chokes the flow of cooling air and results in excessive operating temperature.

Exterior. Loose dust accumulated on the outside of the Type RM527 can be removed with a cloth or small paint brush. The paint brush is particularly useful for dislodging dust on and around the front-panel controls. Stubborn dirt can be removed with a soft cloth dampened in a mild solution of water and detergent. Abrasive cleaners should not be used.

Clean the face of the crt and the graticule with a soft, lint-free cloth dampened with denatured alcohol.

CAUTION

Avoid the use of chemicals which might damage the plastics used in this instrument, particularly the lucite plastic graticule. Some chemicals to avoid are benzene, toluene, xylene, acetone or similar solvents.

Interior. Even if air entering the Type RM527 is filtered, some dust may penetrate into the interior of the instrument. This dust should be removed occasionally due to its conductivity under high humidity conditions. The best way to clean the interior of the equipment is to first carefully vacuum all accessible areas and then blow away the remaining dust with dry, low-pressure air. Avoid the use of high-velocity air which might damage some of the components. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning ceramic terminal strips.

The high-voltage circuits should receive special attention. Excessive dust and dirt in these areas may cause high-voltage arcing and result in improper instrument operation.

Lubrication

The fan should be oiled with a few drops of oil about every six months. An industrial hypodermic syringe and needle is used to insert oil through a protective rubber cap located under the fan label. The oil recommended is Anderol L826 from the Lehigh Company or Rotron distributors, but if not available, a good light machine oil may be used. If a syringe and needle cannot be obtained locally, you can order them through your Tektronix Field Office by specifying Hypodermic Syringe, Tektronix Part No. 003-282 and Hypodermic Needle, Tektronix Part No. 003-285.

Fig. 4-1 shows how to oil the fan. Place the needle at the point on the label shown in Fig. 4-1. With the needle at about 45°, pierce the label and rubber cap (located under the label); insert the needle about 1/4" and depress the syringe-plunger to inject a few drops of oil.

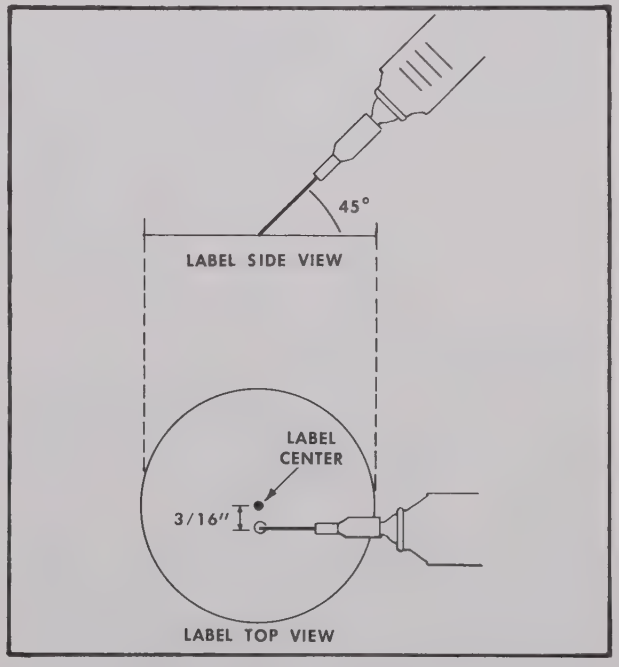


Fig. 4-1. Fan motor oiling with hypodermic.

CORRECTIVE MAINTENANCE

Soldering

Special silver-bearing solder is used to establish a bond to the ceramic terminal strips in Tektronix instruments. This bond can be broken by repeated soldering (especially if ordinary tin-lead solder is used) or by excessive heating. Solder containing about 3% silver is recommended. A small supply of this solder is provided on a spool mounted inside the Type RM527. Additional silver-bearing solder can usually be purchased locally; however, it may be purchased through your Tektronix Field Engineer or representative—specify part number 251-514.

The following procedure is recommended when soldering to ceramic terminal strips:

1. Use a wedge-shaped soldering iron tip about 1/8 inch wide. This allows heat to be applied directly to the solder in the terminal strip, thereby reducing the amount of heat required.

2. Maintain a clean, properly tinned tip.

3. Use a hot iron for a short time. A 50- to 75-watt iron having good heat transfer and storage characteristics is adequate.

4. Avoid putting pressure on the strip. Excessive pressure may crack or chip the strip.

5. Apply only enough heat to make the solder flow freely.

6. Do not attempt to fill the notch on the strip with solder; instead apply only enough solder to cover the wires adequately and establish a solid solder joint. Overfilling the notches may result in cracked terminal strips. If the lead extends beyond the solder joint, clip off the excess as close to the joint as possible. Remove all wire clippings from the chassis.

When soldering to metal terminals (e.g., pins on a tube socket or terminals on a switch) a slightly different technique should be used. Prepare the iron as described previously and apply the iron to the junction to be soldered. Use only enough heat to allow the solder to flow freely along the wire so a solid solder joint is formed. Excessive solder and/or heat may cause the solder to run into the tube socket or onto the switch contacts and ruin the part; on the other hand, inadequate heat will result in a poor electrical connection.

Ceramic Terminal Strips

Fig. 4-2 shows an assembled ceramic terminal strip. Replacement strips with studs attached are supplied under one part number; the spacers are supplied under a separate part number. However, the old spacers may be reused if not damaged.

Usually a strip can be pried out of the chassis or pulled out with a pair of pliers. If desired, a hammer and punch may be used to drive out the studs from the opposite side of the chassis.

When the damaged strip has been removed, place the new or used, but undamaged, spacers in the chassis holes. Then, carefully force the studs of the new strip into the spacers until they are completely seated. If necessary, use a soft-faced mallet and tap lightly directly over the stud area of the strip.

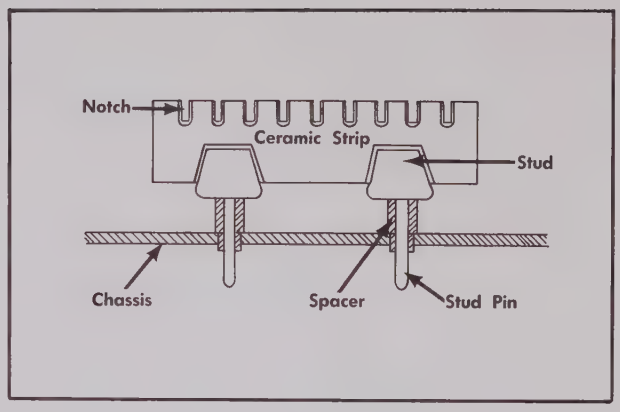


Fig. 4-2. Ceramic strip assembly.

Component Replacement

Certain parts in the instrument are easiest to replace by following a definite procedure. The procedures for replacing these parts are outlined in the following paragraphs.

Many electrical components are mounted in a particular manner to reduce or control stray capacitance or inductance. Attempt to duplicate the original location and mounting when replacing components. When selecting replacement parts, remember that the physical nature of a component can affect its performance at high frequencies.

After repair, check the instrument calibration.

WARNING

Turn off the instrument power before replacing transistors or other components.

Standard Parts

Many of the components in this instrument are standard electronic parts that can be purchased locally. However, all parts in the instrument can be obtained through your Tektronix Field Engineer or representative. Before purchasing or ordering parts, check the parts list in Section 6 to determine the value, tolerance and rating required.

Special Parts

Some of the parts in the instrument are manufactured or selected by Tektronix to meet specific requirements, or are manufactured for Tektronix to our specifications. These parts and most mechanical parts should be ordered through your Tektronix Field Engineer or representative. See "Parts Ordering Information" and "Special Notes and Symbols" in Section 6.

Tubes and Transistors

Tubes or transistors should not be replaced unless they are actually defective. If tubes or transistors are removed

and found to be acceptable, be sure to return them to their original sockets. Tube- or transistor-tester checks on the tubes or transistors used in the Type RM527 are not recommended. Testers may indicate a tube or transistor to be defective when it is operating satisfactorily in a circuit, or may fail to indicate tube or transistor defects which affect the performance of the circuit. It is recommended that tubes and transistors be checked by substitution. If the tube or transistor is good, return it to its socket. Unnecessary replacement of tubes or transistors is not only expensive but may also result in needless recalibration of the instrument.

Wafer Switches

Individual wafers of switch assemblies are normally not replaced. Replacement switches may be ordered from Tektronix either wired or unwired; see the parts list for the part numbers.

Cathode-Ray Tube

WARNING

Be careful when handling a crt. Avoid striking it on any object that might cause it to crack and implode. Flying glass from an imploding crt can cause serious injury. Use safety glasses or a plastic face mask for protection.

To remove the cathode-ray tube, first disconnect the socket and the four clip leads connected to the neck of the tube. Do not unsolder the leads going to the Beam Rotator coil. Remove the crt bezel nuts, bezel, graticule, and green filter. Loosen the clamp at the base of the crt. Remove the tube by pushing forward on the base and then pulling the tube straight out through the front panel (see Fig. 4-3).

When the new crt is in place and the clamp is tightened, connect the leads to the neck pins by following the color-code information on the tube shield. Remount the green filter, graticule, bezel, and crt bezel nuts.

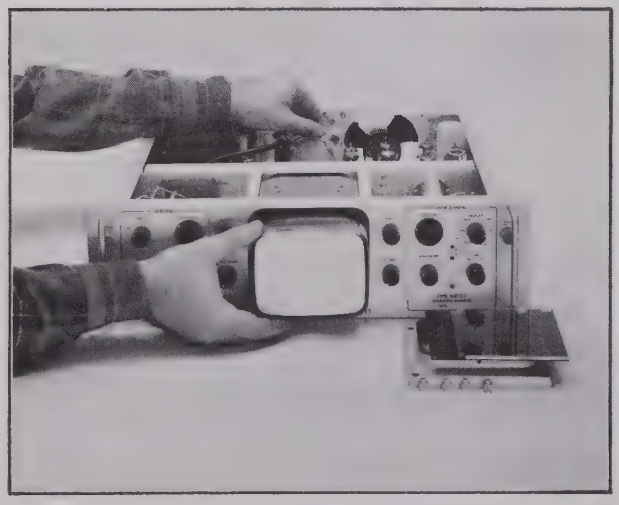


Fig. 4-3. Removing the Type RM527 crt.

After the crt is replaced and the instrument is operating, you should check the horizontal gain, sharpness of the trace, and alignment of the trace with the graticule markings. The procedures for making these checks are described in the Calibration section (Section 5) of this manual.

TROUBLESHOOTING AIDS

Schematic Diagrams

Schematic diagrams for each circuit in this instrument are located at the back of this manual. In addition, a block diagram provides an overall picture of instrument operation. The circuit reference designation for each electronic component in the instrument is shown on the circuit diagrams along with important voltages and waveforms. Component description and tolerance is given in Section 6 of this manual.

The following list shows the circuit reference designations associated with each circuit in this instrument.

Circuit Numbers

1— 44	Sweep Trigger
45—199	Sweep Generator
300—399	Horizontal Amplifier
400—599	Vertical Amplifier
600—699	Power Supply
800—899	Crt Circuit and Calibrator

Switch Wafers

Switch wafers shown on the schematic diagrams are coded to indicate the position of the wafer in the complete switch assembly. The number portion of the code refers to the wafer number counting from the front or mounting end of the switch toward the rear. The letters "F" and "R" indicate whether the front or rear of the wafer is used to perform the particular switching function.

Wiring Color-Code

All wiring in the Type RM527 is color-coded to facilitate circuit tracing. The widest color stripe identifies the first color of the code. The background color indicates the following: white, positive voltage; black, negative voltage.

The regulated power-supply wiring is identified by the following code.

+280	red-gray-brown on white background
+140	brown-yellow-brown on white background
—140	brown-yellow-brown on black background

The heater wiring is indicated by a white background and a blue first stripe. The remainder of the wiring in the Type RM527 is not color-coded in any particular manner; the color used is to facilitate point-to-point circuit tracing within the instrument.

Resistor Color-Code

Composition resistors used in this instrument are color-coded according to the EIA color code.

TROUBLESHOOTING

General Information

This portion of the Instruction Manual includes information to facilitate more efficient troubleshooting of the Type RM527 if a trouble develops. During troubleshooting, information contained in this section of the manual should be correlated with information obtained from other portions of the manual.

In general, troubleshooting an instrument can be divided into two parts: isolating the trouble to the originating circuit, and the actual location of the defective component. The following general procedures are included to help isolate the trouble to the circuit involved. The circuit troubleshooting information should be used to locate the defective component.

Circuit Isolation

The Type RM527 can be divided into 6 major circuits. These circuits are:

1. Sweep Trigger.
2. Sweep Generator.
3. Horizontal Amplifier.
4. Vertical Amplifier.
5. Power Supply.
6. Crt Circuit and Calibrator.

Although the Type RM527 is a stable instrument, it is possible for circuits to get out of calibration, thereby producing an apparent trouble. Before proceeding with any detailed trouble analysis, be sure the trouble cannot be corrected by means of a normal calibration adjustment. If there is any doubt, recalibrate the entire suspected circuit using the procedure given in Section 5.

When a trouble occurs in the instrument, first recheck the settings of all controls to see that they are set properly. Then turn the front-panel controls throughout their range to see what effect, if any, they have on the trouble. The normal or abnormal operation of each control may help to indicate the circuit in which the trouble is located.

If the instrument does not operate at all, check the obvious things first. Check whether the instrument is plugged in and there is power at the socket. Check the line fuse. Check that the tube heaters are lit. When the obvious indications of trouble have been checked, proceed to a more detailed analysis of the trouble.

Unusual troubles may often occur due to a failure in one of the low-voltage power supplies. Also, the circuits of the Type RM527 make it possible for an incorrect voltage to affect one circuit more than another. Consequently, a power supply trouble should be considered as a possibility in virtually any type of failure which may occur within the instrument. If there is any doubt as to whether a power supply may be causing the trouble, the regulated output and ripple of that supply should be checked before proceeding further with the troubleshooting procedure. If the output voltage and ripple of a regulated power supply are correct, that supply can be assumed to be operating properly.

Circuit Troubleshooting

After the trouble has been isolated to a particular circuit, perform a complete visual check of that circuit. Many troubles can be found most easily by visual means. If a visual check fails to detect the cause of the trouble, check the tubes or transistors used in that circuit by replacing them with tubes or transistors known to be good. Most of the troubles which occur in Tektronix instruments result from tube or transistor failures. Be sure to return any tubes found to be good to their original sockets. If the trouble is not the result of a tube or transistor failure, use the following procedure.

1. Isolate the trouble to a portion of the circuit if possible.

2. Recheck the reaction of the front-panel controls and calibration adjustments on the affected circuit.

3. Check the voltages in the circuit. Typical operating voltages are given on the schematic diagram.

4. Check waveforms in the circuit with another oscilloscope. Typical waveforms are given on the schematic diagram.

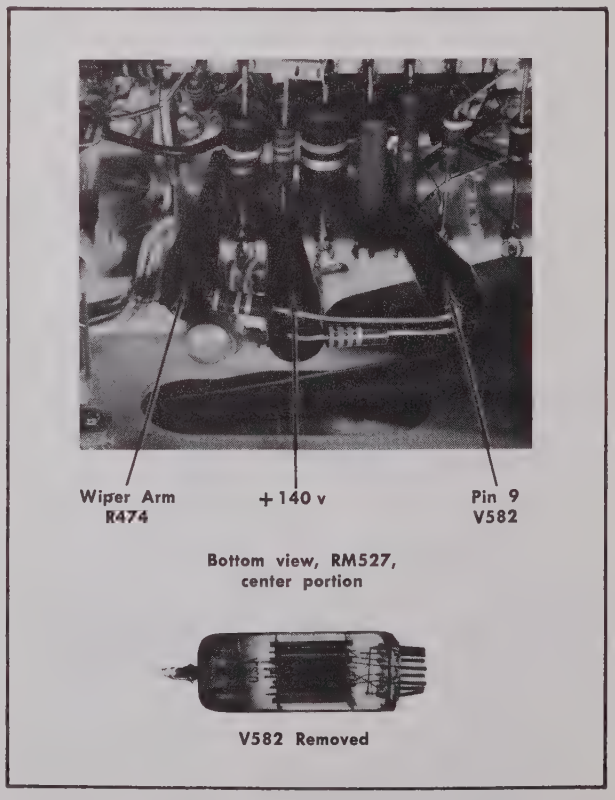


Fig. 4-4. Method 1 for disabling the DC Restorer action.

5. Check the components in the circuit (i.e., check for faulty capacitors, off-tolerance resistors, etc.).

Troubleshooting Tables

In the troubleshooting tables that follow, reference is made in several places to the use of an oscilloscope to check the waveform at some point in the circuit. Because of the fast rise and short time duration of some of the waveforms, it will be necessary to use a wide-band oscilloscope for these checks. A 5-mc instrument is the minimum. If possible, a 10-mc (or better) oscilloscope should be used.

Tables 4-1 and 4-2 can be used to troubleshoot the instrument. Table 4-1 lists possible symptoms or apparent troubles that could be encountered. This table can be used to isolate certain troubles to a main circuit and, in some cases, to a particular stage or component within a main circuit. Table 4-2 can then be used to locate the trouble in the isolated main circuit or in a particular part of the main circuit. References in Table 4-1 direct you to the appropriate step or steps in Table 4-2.

It is clearly not possible to include all conceivable troubles in a troubleshooting table, and therefore only those troubles most likely to occur are included. Troubles not found in the tables must be located using the general method of first isolating the defective stage and then determining the cause of the trouble within the stage.

Table 4-2 can also be used independently. The steps in Table 4-2 are arranged so they can be used to perform a quick check on the operation of each main circuit. The table is subdivided into separate sections for the circuits contained in the instrument, so if you isolate a trouble to a main circuit, you can proceed directly to the appropriate section of Table 4-2 without first using Table 4-1.

TABLE 4-1

TROUBLE	PROBABLE CAUSE	CHECKS TO MAKE	IF NORMAL	IF ABNORMAL
1. Scale illumination, pilot light and tube heaters do not light.	Line power not applied. Fuse F601. Power switch SW601. Power Transformer T601.	See that oscilloscope is properly connected to the power source. Then check for correct line voltage between terminals 1 and 4 of T601.	T601 is probably defective.	F601 or SW601 is probably defective.
2. No video waveform display or trace on the screen with INPUT switch set to either A or B, INTENSITY control set for normal brightness, and POSITION controls centered.	Loss of video signals to A and B connectors. SYNC switch set to EXT when no external sync is used. Causes of trouble can be external to the Type RM527, or can be internal. Proceed to next columns and follow instructions.	1. Check the signal source for 0.25-volt or more signal. Set the SYNC switch to INT.	Proceed to check 2.	Apply proper amplitude video signal to VIDEO INPUTS A connector.
		2. Set INPUT switch to CAL, CALIBRATOR switch to .714, DISPLAY switch to .125 H/CM and MAGNIFIER to X1. The calibrator waveform should appear.	Troubleshoot from the VIDEO connectors to INPUT switch SW404.	Proceed to check 3.
		3. Check for correct regulated power-supply output voltages of all supplies including the —3800-volt supply.	Proceed to check 4.	If one or more of the power-supply voltages are abnormal, check supply. For —140-volt supply refer to step 1; for +140-volt supply refer to step 10; for +280-volt supply, refer to step 17; for —3800-volt supply, refer to step 18. Table 4-2 contains all steps listed above.
		4. Short vertical deflection plates together with jumper lead. Trace should appear.	Remove jumper and proceed to Vertical Amplifier Introduction which precedes step 28, Table 4-2.	Remove jumper and proceed to check 5.

TABLE 4-1 (continued)

TROUBLE	PROBABLE CAUSE	CHECKS TO MAKE	IF NORMAL	IF ABNORMAL
		5. Apply correct amplitude sync pulses to EXT NEG SYNC INPUT connector. Set INPUT switch to A with signal applied to VIDEO INPUTS A. Video waveform should appear.	Troubleshoot Internal Sync Amplitude stage, V14. Also, refer to step 37, Table 4-2.	Proceed to check 6.
		6. Check waveforms at pin 8, V161 and pin 1, V145 in the Sweep Generator.	Proceed to check 7.	If waveform at pin 8, V161 is normal but waveform at pin 1, V145 is abnormal, proceed to step 45, Table 4-2. If neither waveform appears, proceed to step 40, Table 4-2.
		7. Up to this point the only main circuit that remains to be checked is the Horizontal Amplifier circuit. To see if Horizontal Amplifier is at fault, remove V384. A vertical trace should appear that varies in amplitude according to signal changes.	Proceed to step 47, Table 4-2.	Proceed to step 20, Table 4-2.
3. Trace not focused properly.	FOCUS and ASTIG controls not adjusted correctly. CRT circuit.	Adjust FOCUS and ASTIG controls as described in Calibration procedure, Section 5. Trace should focus properly.	Trace focuses properly and instrument operates normally.	Proceed to step 18, Table 4-2.
4. Trace does not align with horizontal graticule lines.	CRT BEAM ROTATOR control not set correctly. CRT circuit in instruments below S/N 151; Power Supply circuit in instruments S/N 151 and up.	Adjust CRT BEAM ROTATOR control as described in Operating Instructions. Trace should align with graticule markings.	Trace aligns properly.	Trouble in Beam Rotator circuit. Check continuity of L860 and voltages applied to circuit.
5. No calibrator pulse display.	T801 secondary open. Transistor Q874 defective. Zener diode D882 shorted. Trouble in associated calibrator circuitry.	Check waveform at base of Q874. Normal waveform should be displayed on test oscilloscope.	Troubleshoot for possible circuit discontinuity between CALIBRATOR switch, SW-880, and the INPUT switch, SW404. Use oscilloscope to trace waveform to source of trouble.	If waveform is not displayed, proceed to step 27, Table 4-2. If waveform is abnormal, proceed to step 26, Table 4-2.
6. Excessive calibrator pulse amplitude display. Video waveform amplitude normal.	D882 open.	Check waveform at collector of Q874. If D882 is open, waveform amplitude will be 20 volts peak-to-peak, instead of normal 6-volts.	Waveform is abnormal, proceed to If Abnormal column.	Replace D882.

TABLE 4-1 (continued)

TROUBLE	PROBABLE CAUSE	CHECKS TO MAKE	IF NORMAL	IF ABNORMAL
7. Insufficient vertical deflection, both A and B channels.	V424, V524, V444, V544, V453, V464, V564 and associated circuitry in the Vertical Amplifier.	Check tubes by substitution first.	Check components which can affect the gain but not the dc balance of the circuits, such as the GAIN switch SW405, plate-dropping resistors, screen resistors.	Replace the defective tubes as required. Adjust DC BAL control; see Calibration procedure.
8. Poor common-mode rejection with the INPUT switch set to A-B and GAIN switch set to HIGH.	V413 and associated circuitry in the Vertical Amplifier.	Check V413.	Check all input circuitry from input connectors to grids of the following stage, V424-V524.	Replace the defective tube.
9. Poor common-mode rejection with INPUT switch set to LOW.	C406 and C506 incorrectly adjusted.	Adjust C406 and C506; see Calibration procedure.	Trouble is corrected.	C406 or C506 defective.
10. Low-frequency waveform distortion (characterized by "tilt" on vertical sync pulse tip).	Troubles in the Vertical Amplifier such as faulty tubes and grid current flow. C412 or C417 defective.	Check tubes in Vertical Amplifier.	Check the push-pull stages for grid current. Locate and correct cause of trouble. Check C412 or C417 for possible cause.	Replace the defective tube(s) as required. Adjust DC BAL control; see Calibration procedure.
11. High-frequency waveform distortion. (Characterized by excessive "overshoot" or "undershoot" at the leading edge of horizontal sync pulses, insufficient bandpass characteristics.) GAIN switch set to HIGH.	Troubles in the Vertical Amplifier such as: faulty tubes, improper adjustment of the peaking coils, bypass capacitors open or shorted.	Check tubes in Vertical Amplifier.	Check for shorted or partially shorted peaking coils.	Replace the defective tube(s) as required. Adjust DC BAL control; see Calibration procedure.
12. Mid-frequency waveform distortion only with the GAIN switch set to LOW.	C406 set incorrectly.	Check adjustment of C406. See Calibration procedure.	Mid-frequency distortion corrected.	C406 defective. Replace.
13. FIELD SHIFT button does not cause fields to shift.	Defective SW178, R178, R179 or C178.	Check switch SW178 for continuity when switch is depressed.	Check R178, R179, and C178.	Replace the defective switch SW178.
14. Nonlinear sweep.	Nonlinear sweep sawtooth caused by the Sweep Generator or sweep amplifier circuts.	Observe waveform at pin 8, V161 (Sweep Generator circuit).	Proceed to step 46, Table 4-2.	Proceed to step 47, Table 4-2.
15. Free-running sweep.	SWP GATING MULTI BIAS adjustment (R176) set incorrectly.	Adjust R176 for correct setting; see Calibration procedure.	Sweep should trigger properly.	If sweep free runs and cannot be triggered, proceed to step 44, Table 4-2.
16. No horizontal deflection. Screen glows when INTENSITY control is set fully clockwise. Screenglow area changes as the VERTICAL POSITION control is rotated.	Change in dc level, starting at grid of V374A. Change in dc levels because of troubles in V374 and V384 Horizontal Amplifier stages.	Check V343, V374 and V384.	Troubleshoot associated circuitry.	Replace the defective tube(s) as required.

TABLE 4-1 (continued)

TROUBLE	PROBABLE CAUSE	CHECKS TO MAKE	IF NORMAL	IF ABNORMAL
17. No horizontal deflection (spot or vertical trace is at center of crt and cannot be positioned with the HORIZONTAL POSITION control).	V374 or V384 filament open.	Check V374 and V384.	Trouble is corrected.	Proceed to step 48, Table 4-2.
18. Insufficient horizontal deflection (short trace).	Sweep sawtooth produced by Sweep Generator stage low in amplitude, or trouble in Horizontal Amplifier circuit. HORIZ GAIN control may need adjusting.	Substitute tubes in Horizontal Amplifier (V343, V374, V384). Check adjustment of HORIZ GAIN control.	Trouble is corrected.	Check waveform amplitude at pin 8, V161. Sweep may revert too soon. If so, check R170, R172, and R173. If amplitude is still low, check V161. If amplitude is normal, proceed to step 47, Table 4-2.

TABLE 4-2

STEP	IF NORMAL	IF ABNORMAL
—140-Volt Power Supply		
1. Check for —140 volts at output of —140-volt supply. Use an accurate (1%). voltmeter.	Proceed to step 2.	If voltage is not zero, proceed to step 5. If voltage is zero, proceed to step 7.
2. Set INPUT selector switch to A and disconnect video signal from VIDEO INPUTS A. Check full-wave ripple at output of —140-volt supply. Should be approximately 5 mv or less, but no more than 20 mv (at nominal line volts).	Proceed to step 3.	Check V626 and V627. If still abnormal, proceed to step 3.
3. Check full-wave ripple at + side of C614A.	Proceed to step 4.	Check C614A. If C614A is good, proceed to step 4.
4. Connect instrument to variable autotransformer. Check that —140-volt supply regulates when line is varied between 105 and 125 volts (if wired for 117-volt operation) or 210 and 250 volts (if wired for 234-volt operation).	Power Supply is operating correctly.	
5. Using the —140 V control, attempt to set output of power supply to —140 volts. It should be possible to obtain the correct voltage.	Trouble has been corrected. Check regulation (step 4).	Check that output varies as —140 V control is adjusted. If it does, check R631 and R632. For further checks proceed to step 6.
6. Disconnect R627 and the external load to the —140-volt supply. Check regulation of —140-volt supply again. Check R627 at this time.	—140-volt supply operates normally. Check for trouble in load circuits. V627 possibly weak; check this tube.	If supply does not regulate, measure voltage across C614A at nominal line. If abnormal, check rectifiers D614, A, B, C, and D. Otherwise, proceed to step 7. Replace R627 if defective.
7. Measure rms voltage between terminals 12 and 13, T601.	T601 is operating properly.	T601 defective (shorted turns in winding connected to terminals 12 and 13, or a turn shorted to another winding).
8. Measure voltage at the plate of V626B.	If normal, check V627 and associated circuits. After finding trouble, proceed to step 9.	If abnormal, check V619, V626, and V627. Check associated circuits. After finding trouble proceed to step 9.

TABLE 4-2 (continued)

STEP	IF NORMAL	IF ABNORMAL
9. Reconnect load and R627 to —140-volt supply. Adjust —140 V control for output of —140 volts.	Check ripple and regulation by repeating steps 3 and 4.	
+140-Volt Power Supply		
10. Check for +140 (±4.2) volts at the output of the +140-volt supply.	Proceed to step 11.	If voltage is incorrect by a small amount (4% or 5%) but seems to regulate, check R661 and R662. Proceed to step 11 and check ripple voltage. If voltage is low, check V657. If voltage is zero, proceed to step 15.
11. Place INPUT switch to A and disconnect video signal from VIDEO INPUTS A. Check ripple at output of the +140-volt supply. Should be approximately 5 mv or less, but no more than 20 mv (at nominal line volts).	Proceed to step 12.	Check V654 and V657. If still abnormal, proceed to step 12.
12. Check ripple at the + side of C612A.	Proceed to step 13.	Check C612A.
13. Connect instrument to a variable autotransformer. Check that supply regulates when line is varied between 105 and 125 volts (if wired for 117-volt operation).	Power supply operating normally.	Check rectifiers D612, A and B. Proceed to step 14.
14. Measure plate voltage of V654. If output of supply is high, V654 should be conducting heavily to decrease the grid voltage of V657. If output is low, V654 should nearly cut off to raise the grid voltage of V657. Measure resistance to ground at +140-volt test point, with negative ohmmeter lead connected to ground. Reading should be approximately 11.5 k.	Voltage and resistance readings are normal.	If resistance at test point is high or low, disconnect R657 and the external load to the supply. Check regulation of the +140-volt supply. If it regulates, trouble is in load circuits. If it does not regulate, proceed to step 15.
15. Measure voltage across C612A.	Check V657. Check R657 at this time while it is disconnected.	Proceed to step 16.
16. Check voltages between terminals 14 and 15, and 15 and 16, of T601. After performing this step, reconnect the load and R657. Repeat steps 10 and 11.	Check rectifiers D612, A and B.	T601 defective.
+280-Volt Power Supply		
17. Use the same general troubleshooting procedure described for the +140-volt supply. (Typical resistance-to-ground measurement of this supply is approximately 17.5 k with negative ohmmeter lead connected to ground.)		
CRT Circuit		
18. Check for —3800 volts at the junction of B847 and R847.	Proceed to step 19.	If voltage is —140 volts or less, proceed to step 24. If voltage is near —3800 volts, proceed to step 23. If the voltage is between —4100 volts and —4900 volts, replace V814.

TABLE 4-2 (continued)

STEP	IF NORMAL	IF ABNORMAL
19. Vary the setting of the INTENSITY control, and vary line voltage between 105 and 125 volts (117-volt operation) while checking voltage at junction of B847 and R847. The supply should regulate between these limits.	If supply regulates, operation is normal. Proceed to step 20.	Proceed to step 23 (If Abnormal column).
20. To check crt, see if neon bulbs B847 and B848 increase in brightness as INTENSITY control is rotated clockwise.	If neon bulbs change in brightness, the crt is operating normally.	If no trace appears on crt, use an oscilloscope to check for unblanking pulse at pin 1, V145 (or remove crt socket and check for unblanking pulse at pin 7 of the socket). If neon bulbs do not change in brightness, check crt voltages before replacing crt. Proceed to step 21.
21. Check crt filament circuit.	Proceed to step 22.	Crt filament may be open; filament leads from terminals 17 and 18 of T601 may be open; T601 winding to terminals 17 and 18 may be open. Replace defective wire or component.
22. Check FOCUS control. Check voltages at pins 4, 6 and 11 of the crt.	Supply voltages to crt are normal. Trouble is probably a defective crt.	Locate cause of incorrect voltage(s) and correct the trouble (possibly crt).
23. If voltage at —3800 V test point is near correct value, adjust —3800 V (R841) control for proper voltage.	Perform step 19 to check high-voltage regulation.	If voltage cannot be brought to the proper value, or will not regulate, the regulator circuit (V814) is probably faulty. Check V814. Proceed to step 24.
24. Check for heater glow in V822.	Check for open plate lead from V822 to voltage divider, R848 to R839 (R840 on early instruments.)	Proceed to step 25.
25. To check oscillator operation, measure voltage at grid of V800. Or, hold a neon bulb near filament leads of V822. Neon bulb should glow.	Check V822 and T801 secondary winding.	Check V800 and associated circuit.
Calibrator		
26. Check calibrator waveform at base of Q874 (INPUT switch set to CAL).	Calibrator is operating normally.	If the waveform does not have a saturated appearance (flattened lower half of cycle) check Q874. If waveform is not obtained, proceed to step 27.
27. Check continuity of T801 secondary winding after disconnecting coax at T801 end.	Secondary winding of T801 has continuity. Check coax for continuity or short.	If winding is open, replace T801.

Vertical Amplifier

The Vertical Amplifier contains the signal amplifier stages and the dc restorer stages (Back Porch and Vertical Position Comparator, Four-Diode Gate, Back Porch Gate Multivibrator, and DC Restorer Cathode Follower). Most are high impedance circuits, and it is important to use a high-impedance (10 meg or higher) voltmeter, such as a VTVM, for measurements. Even so, errors will be introduced at some points. Also, it is important to use a calibrated oscilloscope, having a bandpass of at least 5 mc, with a low-capacitance probe when signal-tracing.

Servicing procedures in this case must include the servicing of feedback loops, or delays in diagnosing the trouble may result. In such a loop system, if one voltage is wrong, all voltages will probably be wrong. Therefore, the best approach is to break the feedback loop and observe the results. The following procedures list the logical steps for troubleshooting, when you are unable to obtain either the video waveform or the calibrator pulse.

TABLE 4-2 (continued)

STEP	IF NORMAL	IF ABNORMAL
28. To determine whether the trouble is in the amplifier stages or in the dc restorer feedback loop, short grid (pin 1) of V424 to grid (pin 1) of V524.	If trace appears, signal stages from the grids of V424-V524 to the output (crt vertical deflection plates) are normal. The trouble is in the grid circuits of V424-V524, or in the dc restorer feedback loop. Proceed to step 32.	If no trace appears, the trouble is in the amplifier stages. Proceed to step 29.
29. To check amplifier stages, short pin 2 of V464 to pin 2 of V564, with a jumper lead.	Trace should appear. Circuits are normal between this point and the crt.	If trace does not appear, check V464 and V564. Check voltages and components.
30. Remove jumper connecting pin 2 of V464 and pin 2 of V564.	Trace should remain on crt.	If trace does not remain on crt, proceed to step 31.
31. Short between corresponding points on opposite sides of the circuit, starting at the grids of V453 and working back toward the grids of V424-V524.	When trace appears, the stages following the jumper (looking toward the crt) are balanced or normal.	When trace does not appear, the stage immediately following the jumper (looking toward the crt) is causing the imbalance. Check for a defective tube or component, or open connections (for example, open inductors).
32. Disconnect jumper connecting grids of V424 and V524.	If trace appears, the Vertical Amplifier, including the dc restorer, is operating normally.	If trace disappears, check grid circuits of V424-V524 (for example, C412 or C417 may be leaky). Then proceed to step 33 to check dc restorer stages.
33. To check dc restorer feedback loop, short cathode (pin 1) of V464 to cathode (pin 1) of V564. See if VERTICAL POSITION control causes cathode (pin 9) of V572C to move about 30 volts (72 volts to 102 volts).	Check the Back Porch Gate Multivibrator, V595, for probable trouble. Check for possible trouble between V595 and Sync Separator Multivibrator, V35B-V45A. For more details, proceed to step 34 (and possibly step 36).	Check V484 and V572C circuitry.
34. If the cathode of V572C swings 30 volts, check voltage swing at the cathode of DC Restorer V582C. The swing should be about 20 volts (82 volts to 102 volts).	Four-Diode Gate, Back Porch Gate Multivibrator and Sweep Trigger circuits operate normally. Proceed to step 35.	Check the Four-Diode Gate circuits V572A, V572B, V582A and V582B.
35. With cathodes of V464-V564 still strapped together, measure plate voltage of V424 with VTVM. Plate swing should be about 6 volts (about 3 volts on either side of —10.5 volts) as VERTICAL POSITION control is adjusted.	DC restorer circuits are normal. Remove jumper.	Check V424 stage for proper voltages. Check faulty components.
36. Check for proper trigger pulse at the grid (pin 7) of V595A.	Check V595 stage voltages and components. Check diode D596.	Check delay cable (L43) by trying the 2 LINE positions of the DISPLAY switch (SW160). If pulse appears, replace L43. If pulse does not appear, proceed to step 37 (Sweep Trigger circuit).

If the previous steps do not help you find the trouble, you may want to disconnect the dc restorer circuit. Then the feedback loop and the amplifier stages of the Vertical Amplifier may be checked independently. You can then troubleshoot in the normal manner, using an oscilloscope and/or a VTVM. To disable the dc restorer action, use either of the following methods:

METHOD 1—Remove V582. Connect a 470 k, ½-watt resistor from pin 9 of the V582 socket to the wiper arm of the VERTICAL POSITION control R474 (junction of wiper arm lead and R471 on the terminal strip). Connect a 33 k, ½-watt resistor from pin 9 of the V582 socket to +140 volts (see Fig. 4-4).

These alterations permit the VERTICAL POSITION control to feed a dc-bias voltage to the input of V424. The trace can now be positioned vertically on the screen and normal operation, except for dc-restoration, can be obtained.

TABLE 4-2 (continued)

STEP	IF NORMAL	IF ABNORMAL
Note that with the Vertical Amplifier operating and with proper functioning of the Vertical Position Comparator V484, the plate (pin 6) of V484 swings from 72 volts to 95 volts as the VERTICAL POSITION control is rotated (with the GAIN control set to HIGH and rotated fully counterclockwise). Cathode follower V572C should follow, but considering its bias, the cathode of V572C will run about 8 volts higher than the plate of V484. (The trace movement will lag slightly in response as the VERTICAL position control is rotated.) With this setup, the dc restorer feedback loop is open, and the Back Porch Gate Multivibrator waveforms are affected slightly both in duration and amplitude as the VERTICAL POSITION control is rotated. However, this will not interfere with troubleshooting the amplifier stages. METHOD 2—This method disables the Back Porch Gate Multivibrator in such a manner that the Four-Diode Gate is always closed, causing continuous feedback. To produce this condition, the multivibrator must be biased into its normally astable state. To do this, connect a 330 k, ½-watt resistor from +140 volts to the junction of R590, R591 and R592. Trigger the instrument externally, but do not apply any signal to the Vertical Amplifier. The dc feedback loop will function, and there should be normal positioning range with no trace drift. With the GAIN control set to HIGH and rotated fully counterclockwise, the plate (pin 6) of V484 should swing from 79 to 85 volts as the VERTICAL POSITION control is rotated.		
Sweep Trigger		
37. Apply a composite video signal to VIDEO INPUTS A connector. Set INPUT switch to A and SYNC switch to INT. Use an oscilloscope to check waveform at pin 2, V35.	Proceed to step 38.	Check V14 and V24. Check voltages at tube pins. Check diodes D14, D16 and D19. (In later circuits check diodes D4, D7 and D32 also.)
38. Check waveforms at pin 1, V35 and pin 6, V45.	Sweep Trigger circuit operates normally when triggered with internal sync signals. To check circuit using external sync pulses, proceed to step 39.	Check V35 and V45. Check for an open circuit, such as L34. Diode D44 may be open or shorted. Check TRIG MULTI BIAS adjustment according to information in the Calibration procedure.
39. Apply external sync to EXT NEG SYNC INPUT connector and set SYNC switch to EXT. Check waveform at grid of V24.	External sync input circuit operates normally.	Check C3 and adjustment of C1. Check R1, (R3 in instruments SN101-150 only) R4, R7, D4, D7 and D19 and SYNC switch SW7.
Sweep Generator		
The Sweep Generator is another example of a feedback circuit. When it fails, the problem is to find where the break in feedback occurred. The general procedure is to determine whether the Sweep Generator locks at the start or fails to revert at the end of the sweep.		
40. Measure the voltage at pin 8 (cathode) of V161. If the sweep has not started, the voltage should be +180 volts.	Proceed to step 41.	If voltage at pin 8 of V161 is higher than +180 volts, fault is in feedback loop consisting of V152 and V161. Proceed to step 42. If voltage is lower than 180 volts, proceed to step 43.
41. Check adjustment of the SWP GATING MULTI BIAS control (R176).	Sweep operates normally.	If SWP GATING MULTI BIAS control makes sweep free run but not trigger properly, check for possible absence of triggers. To make this check, proceed to step 44. If sweep does not start, check V45, V145 and associated circuitry.
42. Check tubes in feedback loop (V161 and V152).	Feedback circuit checks should be made. Procced to If Abnormal column of this step and check resistors that are listed.	Check resistors R170, R172, R173, R163, R164 and R165. In addition, check R175 and SWP GATING MULTI BIAS control R176.

TABLE 4-2 (continued)

STEP	IF NORMAL	IF ABNORMAL
43. If the sweep has not reverted, the voltage at pin 8, V161 should be +40 volts.	Sweep should revert at +40 volts. V45B should be cutoff and V145A should be conducting. Proceed to step 44.	Check V152. If voltage at pin 8, V161 reads less than +40 volts (about +20 volts), V145 is defective or pin 2, V161 is shorted to ground. Check coaxial cable going to the DISPLAY switch SW160. Also, try other positions of the DISPLAY switch to see if trouble is in some positions only.
44. Check waveform at pin 2, V45B. Positive-going trigger pulses should appear on the waveform.	Sweep triggers properly. Proceed to step 45 and check for presence of unblanking pulse.	Check back toward Sync Separator Multivibrator stage with oscilloscope. Check diode D44 and capacitor C44. Also, check adjustment of TRIG MULTI BIAS control (R39) according to instructions in Calibration procedure.
45. Check waveform at pin 1 (cathode) of V145. Normal waveform unblanks the crt and permits waveform to be displayed.	Proceed to step 46 for final check of sweep sawtooth waveform.	
46. Check waveform at pin 8, V161 for final check on waveform linearity.	Sweep Generator operates normally.	If sweep is nonlinear, check for defective timing capacitors. Rotate DISPLAY switch one position at a time to isolate cause. Check V161.
Horizontal Amplifier		
47. Check waveform and its dc level at pin 2, V343.	Proceed to step 48.	Check setting of HORIZONTAL POSITION control (wiper arm voltage should be —70 volts) and check V343. If waveform is nonlinear make further checks in this circuit.
48. Check waveforms and their dc level at pins 1 and 6, V374.	Proceed to step 49.	Check V374 and voltages.
49. Check waveforms and their dc level at pins 6 and 1, V384.	Horizontal Amplifier normal (with possible exception of HORIZ INPUT circuit). To check HORIZ INPUT circuit, proceed to step 50.	Check V384 and voltages.
50. Apply a proper amplitude 20-cycle staircase signal to HORIZ INPUT (CPXR) connector. DISPLAY switch must be set to RGB FIELD or LINE.	Circuit operates correctly.	Check V343 and associated circuitry.

NOTES

SECTION 5

CALIBRATION

Introduction

The Type RM527 Waveform Monitor is a stable instrument which will provide many hours of trouble-free operation. However, to insure measurement accuracy, it is suggested that you recalibrate the instrument after each 500 hours of operation or every six months if used intermittently. It will also be necessary to recalibrate certain sections of the instrument when tubes, transistors, or other components are replaced.

In the instructions that follow, the steps are arranged in the proper sequence for full calibration. Each numbered step contains the information necessary to make one adjustment. If a complete calibration is not necessary, you may perform individual steps providing that the steps performed do not affect other adjustments. It is most important that you are fully aware of the interaction of adjustments. Generally speaking, the interaction of controls will be apparent in the schematic diagram. If you are in doubt, check the calibration of the entire section on which you are working.

If you make any adjustments on the power supplies, you will have to check the calibration of the entire instrument.

Equipment Required

The following equipment is required to perform a complete calibration of the instrument.

1. DC voltmeter having a sensitivity of at least 5000 Ω/v and calibrated for an accuracy of at least 1% at 140 and 280 volts, and for an accuracy of at least 3% at 3800 volts. Portable multimeters should be regularly checked against an accurate standard and corrected readings noted, where necessary, at the above listed voltages.

2. Precision dc voltmeter such as the Fluke Model 803 or the Electro Instruments Model Eitronic 880. Required characteristics: Input resistance at least 1 megohm. Accuracy at least ±0.05% of reading at 1 volt. If desired, a differential comparator such as Tektronix Type Z Plug-In may be substituted for the precision voltmeter.

3. Sine-wave generator, Tektronix Type 190B Constant-Amplitude Signal Generator, or equivalent. Required specifications: Output frequencies of 50 kc, and a variable range from 350 kc to 9 mc; output amplitude of approximately 10 volts, adjustable (manually or automatically) for constant amplitude at the frequencies stated.

4. Test oscilloscope, such as a Tektronix 530-, 540- or 550-series oscilloscope with a Type B plug-in, and having an approximate 20-volt positive square-wave pulse available whose duration coincides with the sweep duration. The oscilloscope must also have a bandpass of dc to 10 mc, and a vertical deflection factor of at least 0.05 volts/cm.

5. A 1× and a 10× compensated probe for the oscilloscope.

6. Square-wave generator, Tektronix Type 105 Square-Wave Generator or equivalent. Required specifications: A variable output frequency from 20 cps to 10 kc; a variable output amplitude from 10 to 100 volts across a 600-ohm load.

7. Time-mark generator, Tektronix Type 180A Time-Mark Generator or equivalent. Required specifications: Time marker intervals of 1 μsec and 5 μsec; sine-wave output of 5 mc; available external triggering pulses having an interval of 100 μsec.

8. An accurate rms-reading ac voltmeter, having a range of 0-150 volts (0-250 or 0-300 for 234-volt operation).

9. Variable autotransformer having a rating of at least 6.25 amperes.

10. Composite video signal source; signal amplitude, 1 volt.

11. Attenuator, 5×T, 75-ohm, Tektronix Part No. 011-034.

12. Attenuator, 10×T, 75-ohm, Tektronix Part No. 011-033.

13. Termination, 75-ohm, Tektronix Part No. 011-023.

14. Suggested tools: Screwdriver having a shank 3½" long by 3/32" in diameter; low-capacitance screwdriver, Tektronix Part No. 003-000; 1/16" hexagonal wrench; double-ended 0.1" hexagonal wrench, Tektronix Part No. 003-301; alignment tool consisting of a handle (Tektronix Part No. 003-007) and a hexagonal core insert (Tektronix Part No. 003-310).

PRELIMINARY INSTRUCTIONS

The instrument should be removed from any enclosure so as to provide easy access to all internal and rear-panel controls, connectors, and components.

Set the front-panel controls as follows:

Crt Controls

INTENSITY	Fully counterclockwise
FOCUS	As is
SCALE ILLUM	AC OFF

Vertical Controls

INPUT	A
RESPONSE	FLAT
GAIN	Switch to HIGH and then rotate the GAIN control fully counterclockwise, but not switched into LOW
POSITION	Midrange

Horizontal Controls

POSITION	Midrange (5 full turns from either end)
MAGNIFIER	×1
SYNC*	INT
DISPLAY	2 LINE

Other Controls

CALIBRATOR	1.0

NOTE

Pictures on a fold-out page preceding the schematics show the location of each calibration control and each of the test points listed in the calibration procedure.

Before applying power to the instrument, the resistances of the power supplies should be checked. The typical resistances of the supplies may be found in the chart below.

Nominal Resistances of Power Supplies

Supply	Test Point	Approx. Resistance to ground
—140	End of R487	10 k
+140	Pins 1 or 3 of V484	3 k
+280	End of R468	7 k

Connect the power cord and the ac voltmeter to the output of the autotransformer. Turn the SCALE ILLUM switch away from the AC OFF position and adjust the autotransformer for an output voltage to match the design center voltage of the oscilloscope. Allow the instrument to warm up for several minutes before proceeding with the calibration adjustments. During calibration, periodically check the input voltage to the instrument and adjust the autotransformer as necessary to maintain the voltage at the design center voltage except when the power supply regulation is being checked.

CAUTION

Do not reset the —140 V control unless the power supply voltages are actually out of tolerance or you are planning to perform a complete calibration of the instrument.

PROCEDURE

1. Adjust and Check Low-Voltage Power Supplies

Measure the output voltage of the —140 V, +140 V, and +280 V regulated supplies at the points indicated on the fold-out page. The output voltage of the —140 V must be within 1% of its rated value. The other regulated supplies must be within 3% of their rated values. You should set the —140 V control so all of these voltages are within the specified tolerance.

To check the regulation of the power supplies, adjust the line voltage for 105 volts. Now check the voltage of each supply. The —140 V supply should be within 1%, while the +140 V and +280 V supplies should still be within 3% of their proper values.

The power supply ripple is checked by connecting a 1× probe from the test oscilloscope to the supply being checked. The table below gives the approximate ripple amplitudes of each power supply.

After the power supplies have been checked on low line voltage, the line voltage should be raised to 125 volts. Repeat the voltage and ripple checks. The same limits apply.

When the power supply regulation checks are completed, return the line voltage to the design center voltage.

Typical Ripple Amplitudes

Supply	Typical Ripple
—140	20 mv
+140	20 mv
+280	30 mv

2. Adjust High-Voltage Power Supply

Connect the voltmeter between ground and the junction of B847 and R847. Adjust the —3800 V (R841) control for a meter reading of —3800 volts. Turn the INTENSITY control fully clockwise; the high voltage should remain essentially constant (within ±190 volts) over the range of the INTENSITY control. Return the INTENSITY control to its fully counterclockwise position. Disconnect the voltmeter.

3. Adjust Calibrator Amplitude

Set the INPUT selector switch to CAL.

Two methods for accurately adjusting the calibrator amplitude are described: The Tektronix Type Z Plug-In method, and the precision voltmeter method.

To use the Type Z Plug-In method, install the Type Z into a Tektronix plug-in type oscilloscope such as a 530-, 540-, or 550-series. Set the controls of the test oscilloscope/Type Z as follows:

Test Oscilloscope

Mode	Automatic
Slope	+
Coupling	AC
Source	Internal
Time/div	.1 mSec

Type Z

'A' Volts/cm	.05
'A' Ac-dc	Dc
Mode	A-Vc
Polarity	—
Range	1 v
Helidial	0.00

***Located on rear panel of instruments S/N 101-149.**

Connect a 1× probe from the 'A' Input connector of the Type Z to the junction of R882 and R884 in the Type RM527. Obtain a stable display of the pulse tops, then position the line of pulse tops to a convenient reference point on the graticule of the test oscilloscope.

Turn the helidial to 10.00 and note the position of the line of pulse bottoms; it should be at the reference point that was established with the pulse tops. If the pulse bottoms are not on the reference point, remove the CALIBRATOR knob and use the $^3/_{32}$" diameter screwdriver to adjust the CAL AMPL control (R886) through the hollow shaft of the CALIBRATOR switch until the pulse bottoms are at the reference point. When the adjustment is completed, disconnect the probe and reinstall the CALIBRATOR knob.

The .714 position of the CALIBRATOR switch may be checked with the same method used above to adjust the amplitude of the 1.0 volt calibrator signal. The probe is connected to the junction of R880 and R882, the reference point established, and the helidial then set to 7.14 ±0.07 division.

To use the voltmeter method, turn off the instrument and remove V800 to disable the high-voltage oscillator. Turn the instrument back on, set the precision dc voltmeter for 1.00 volt, connect the voltmeter to the junction of R882 and R884, and adjust the CAL AMPL control (R886) for null reading on the meter.

NOTE

The operation of the calibrator is such that when the voltmeter method is used, the calibrator voltage will tend to be low. Therefore, the voltmeter reading should actually be 1 to 3 millivolts higher than the 1-volt setting previously given. The CAL AMPL control should never be set for a meter reading of less than 1 volt.

Turn the instrument off, disconnect the precision dc voltmeter, return V800 to its socket, and turn on the power. Reinstall the CALIBRATOR knob.

4. Preliminary Adjustment of Trig Multi Bias and Swp Gating Multi Bias

With the Type RM527 controls set as in the first part of step 3, adjust the INTENSITY so either a display or a spot is visible. Now adjust the TRIG MULTI BIAS (R39) and SWP GATING MULTI BIAS (R176) for a stable calibrator display. It may be necessary to use the vertical POSITION control to position the complete display onto the crt.

5. Adjust CRT Beam Rotator and Astigmatism

Position the calibrator signal display to the center of the crt and adjust the FOCUS and ASTIG (R864) controls to obtain a well-focused display. Adjust the INTENSITY control to obtain normal viewing intensity.

Set the DISPLAY switch to 2 FIELD and position the trace behind a horizontal graticule line. If the trace and graticule line do not coincide over the width of the graticule, adjust the CRT BEAM ROTATOR (R860) control until they do.

Set the Type RM527 controls as follows before proceeding to step 6.

Crt Controls	
INTENSITY	Usable level
FOCUS	As is
SCALE ILLUM	As is
Vertical Controls	
INPUT	A
RESPONSE	FLAT
GAIN	Set so as to provide a video signal display amplitude of 80 IRE units.
POSITION	Midrange
Horizontal Controls	
POSITION	Midrange (5 full turns from either end)
MAGNIFIER	×1
SYNC	INT
DISPLAY	2 LINE
Other Controls	
CALIBRATOR	.714

6. Adjust Trig Multi Bias

Connect a one-volt composite video signal to one of the VIDEO INPUTS A connectors and set the GAIN control so the signal displayed on the crt has an amplitude of 80 IRE units.

Connect a 10× probe from the vertical input connector of the test oscilloscope to pin 2 of V35. Set the test oscilloscope controls as follows:

Mode	Automatic
Slope	+
Coupling	Ac
Source	Internal
Time/div	1 μSec
Input selector	Dc
Volts/div	0.1 volt

Establish a dc ground reference point on the test oscilloscope by either turning the input selector switch to gnd or by disconnecting the probe and grounding the vertical input connector. Reconnect the signal from pin 2 of V35 to the test oscilloscope. The waveform on the test oscilloscope may be positioned horizontally if desired. However, the vertical positioning control should not be touched since it will move the dc reference point.

Now, with the dc ground reference point established and the signal from pin 2 of V35 displayed, adjust TRIG MULTI

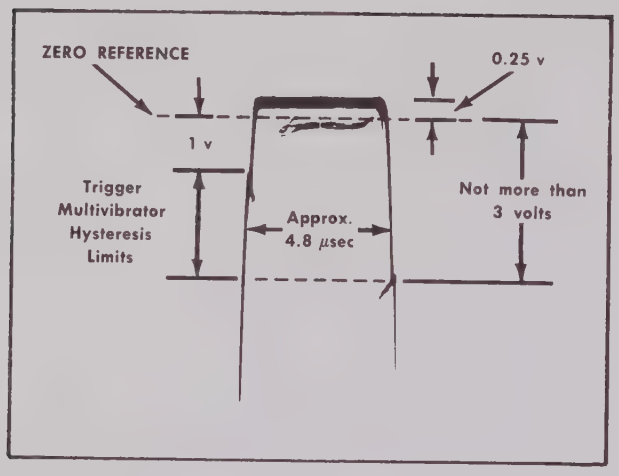


Fig. 5-1. Horizontal sync pulse obtained at pin 2 of V35, when the TRIG MULTI BIAS adjustment is set correctly.

BIAS (R39) so the upper hysteresis level (bright spot on leading edge of waveform) is one volt below the dc ground reference point, see Fig. 5-1.

The lower hysteresis level (bright spot on trailing edge of waveform) should be checked to make sure it is at least one volt and not more than two volts below the upper hysteresis level. Also check to see that the top of the displayed waveform on the test oscilloscope is about 0.25 volt above the dc ground reference point. Remove the probe, but leave the video signal connected.

7. Adjust Sweep Gating Multi Bias

With the one-volt composite video signal still connected to one of the VIDEO INPUTS A connectors, turn the DISPLAY switch to 2 FIELD. Now, while viewing the display on the crt of the Type RM527, turn the SWP GATING MULTI BIAS (R176) control counterclockwise until the display free runs or until you come to the end of the potentiometer, whichever occurs first. Note the shaft position of the potentiometer when the above condition is found. Turn the potentiometer shaft clockwise from the above position until the display disappears. Note the shaft position of the potentiometer for this condition. Turn the potentiometer shaft counterclockwise until the potentiometer shaft position is halfway between the two shaft positions noted above.

Turn the DISPLAY switch to each of its positions and check for a stable display in each one. Return the DISPLAY switch to the 2 FIELD position.

8. Check Sync Switch

With no connections made to the EXT NEG SYNC INPUT connectors, place the SYNC switch to the EXT position. Check that the display disappears.

9. Check Input Switch

With the SYNC switch at EXT, place the INPUT switch to CAL and the DISPLAY switch to 2 LINE. Check for a stable display of the calibrator waveform. Now change the SYNC switch to INT and again check for a stable display of the calibrator waveform.

10. Check Dc Restorer

Leave the Type RM527 controls as in step 9 and use the vertical POSITION control to place the bottom of the calibrator waveform to the 0 IRE graticule line. With the GAIN switch set to LOW, rotate the GAIN knob through its variable range, but not into either detent position. While rotating the GAIN knob through its variable range, check to see that the bottom of the calibrator waveform remains stationary at the 0 IRE graticule line.

Place the INPUT switch to A (one volt of composite video signal still applied to the VIDEO INPUTS A connector), and, with the vertical POSITION control, place the 0 IRE level of the composite video signal to the 0 IRE graticule line. Now, vary the GAIN knob again through its variable range, while making sure that the 0 IRE level of the composite video signal remains stationary at the 0 IRE graticule line. Disconnect the composite video signal.

Place the INPUT switch to CAL, the CALIBRATOR switch to EXT, and turn the GAIN control fully clockwise, but not so the high gain position is switched in. Connect a coaxial cable between a Type 105 Square-Wave Generator and the left EXT CAL INPUT connector on the rear of the Type RM527. Now, between the Type 105 and the coaxial cable, insert a 75-ohm termination, and between the coaxial cable and the Type RM527 connector, insert a 5×T 75-ohm attenuator. This will properly terminate the coaxial cable on each end.

Adjust the Type 105 for an output signal frequency of 10 kc and an output amplitude of about 80 IRE units as displayed on the crt of the Type RM527. Using the vertical POSITION control, place the bottom of the waveform on the 0 IRE graticule line. Turn the GAIN knob through its variable range, and check at the same time that the bottom of the waveform remains on the 0 IRE graticule line.

Remove the Type 105 connection from the left EXT CAL INPUT connector and connect it to the right EXT CAL INPUT connector. Repeat the same procedure for the right connector as was just completed for the left connector.

After completing the check on the right EXT CAL INPUT connector, note the position of the waveform, then turn off the Type RM527 for about 4 or 5 seconds. Turn the Type RM527 on again and check to see that the display returns to its last position before the instrument was turned off.

11. Check External Sync and Adjust C1

Remove the Type 105 connection from the right EXT CAL INPUT connector and connect it to the upper EXT NEG SYNC INPUT connector. Connect a coaxial cable between the lower EXT NEG SYNC INPUT connector and the lower VIDEO INPUTS A connector. Place the INPUT switch to A and adjust the amplitude control of the Type 105 for a displayed waveform amplitude of 100 IRE units.

Change the SYNC switch to EXT and check for a stable display. Place the top of the displayed waveform to the 80 IRE graticule line. With the GAIN switch set to LOW,

rotate the GAIN control through its variable range and check the top of the displayed waveform for no change in position.

Set the controls of the test oscilloscope as follows:

Mode	Automatic
Slope	+
Coupling	Ac
Source	Internal
Time/div	50 μSec
Input Selector	Ac
Volts/div	1 volt

Connect a 10× probe from the test oscilloscope to pin 7 of V24 for instruments above S/N 1079 (connect probe to pin 5 of V24 if instrument is below S/N 1080). Obtain a stable display on the test oscilloscope, then adjust C1 for a flat top on the square-wave display. Disconnect the cable between the lower EXT NEG SYNC INPUT and the lower VIDEO INPUTS A connector, the Type 105 and the upper EXT NEG SYNC INPUT connector, and the 10× probe connection to V24.

12. Check Horiz Input (CPXR)

Place the display switch to RGB LINE and the SYNC switch to INT. Connect a one-volt composite video signal to the upper VIDEO INPUTS A connector, and connect the lower VIDEO INPUTS A and B connectors together with a coaxial cable.

Connect a properly terminated coaxial cable from the Type 105 to the HORIZ INPUT (CPXR INPUT) connector on the rear panel of the Type RM527. Set the Type 105 for a frequency of 20 cps and adjust the amplitude control on the Type 105 so two composite video horizontal lines are displayed on the Type RM527.

Change the DISPLAY switch to RGB FIELD and check for a display of two composite video signals. Disconnect the Type 105 from the HORIZ INPUT (CPXR INPUT) connector. The remainder of the connections should be left as is.

13. Adjust Horizontal Gain (R375)

Place the DISPLAY switch to 2 FIELD, and check to insure that the MAGNIFIER switch is set to ×1. Adjust the HORIZ GAIN control R375 for a 10.2-centimeter trace length ±2 mm.

14. Adjust Swp/Mag Regis (R355)

Place the MAGNIFIER switch to ×25, and use the horizontal POSITION control to position the start of the trace to the graticule center (the small divisions on the 0 IRE graticule line can be used to accurately determine the graticule center). Change the MAGNIFIER switch to ×1, and adjust the SWP/MAG REGIS control (R355) to bring the start of the trace back to the graticule center. Repeat this adjustment several times to remove interaction.

15. Adjust Magnifier Start Compensation (C320, C334, C336)

Place the MAGNIFIER switch to ×1, and use the horizontal POSITION control to position the start of the trace to the center of the graticule. Place the DISPLAY switch to 2 LINE, and adjust C320 so the trace starts in the same position in 2 LINE as it did in 2 FIELD.

Place the DISPLAY switch to 2 FIELD, and the MAGNIFIER switch to ×5. Position the trace start to the center of the graticule, then change the DISPLAY switch to 2 LINE and adjust C334 so the trace starts in the same position as it did in the 2 FIELD position of the DISPLAY switch.

Place the DISPLAY switch to 2 FIELD, and the MAGNIFIER switch to ×25. Position the trace start to the center of the graticule, then change the DISPLAY switch to 2 LINE, and adjust C336 so the trace starts in the same position as it did in the 2 FIELD position of the DISPLAY switch.

16. Adjust Trace Registration (C160C)

Place the MAGNIFIER to ×1, and use the horizontal POSITION control to place the start of the trace to the left side of the graticule. Change the DISPLAY switch back and forth between 2 LINE and 2 FIELD while adjusting C160C so the second composite video horizontal sync pulse in 2 LINE aligns vertically with the second composite video vertical sync pulse in 2 FIELD.

17. Adjust and Check Sweep Timing

Place the DISPLAY switch to .125 H/CM and adjust C160G for 8 centimeters between identical points on the composite video horizontal sync pulses. Remove the one-volt composite video signal from the upper VIDEO INPUTS A connector; also remove the coaxial cable connecting the lower VIDEO INPUTS A and B connectors together.

Connect 5-microsecond time markers from a Type 180A through a 5×T attenuator and to one of the VIDEO INPUTS A connectors. Connect 100-microsecond trigger pulses to one of the EXT NEG SYNC INPUT connectors. Place the SYNC switch to EXT, and adjust the vertical gain and position display so the tips of the time markers are just above the 0 IRE graticule line. Adjust C320 so the time markers at the zero, fifth, and tenth graticule lines are all right on these marks. Check the display to insure that it consists of 16 time markers per 10 centimeters.

Place the MAGNIFIER switch to ×5, and change the controls on the Type 180A so 1-microsecond time markers are applied to the VIDEO INPUTS A connector. The trigger pulses from the Type 180A remain the same. Adjust C334 for timing and linearity. Check to see that the .025 H/CM neon lights, and that there are 16 time markers per centimeter.

Change the MAGNIFIER switch to ×25, and apply 5 megacycles from the Type 180A to the VIDEO INPUTS A connector. The trigger pulses from the Type 180A remain as is. Adjust C336 for linearity on the left half of the graticule. Check the .005 H/CM neon to insure that it lights; also check for 16 cycles per 10 centimeters.

Change the MAGNIFIER switch from one position to the next and then back to the original position while observing any drift in the display. Allowable drift is 0.5 centimeter. Remove all input connections between the Type 180A and the Type RM527.

18. Check Operation of Field Shift Button

Place the DISPLAY switch to 2 FIELD, the SYNC switch to INT, and the MAGNIFIER switch to ×25. Connect one volt of composite video to the upper VIDEO INPUTS A connector, and connect the lower VIDEO INPUTS A and B connectors together with a coaxial cable.

With the horizontal POSITION control, position the display so the end of the vertical sync block may be viewed. Push the FIELD SHIFT button and view a field shift.

NOTE

The field shift is a random operation, but pushing the FIELD SHIFT button should result in a field shift 50% of the time.

19. Adjust Vertical Input Compensation (C406, C506)

Place the INPUT switch to CAL, the CALIBRATOR switch to 1.0, the GAIN switch to LOW and the GAIN knob rotated fully clockwise but not into the high gain position, the MAGNIFIER switch set to ×1, and the DISPLAY switch to VIT. Adjust C406 for the best flat top on the calibrator waveform.

Change the INPUT switch to A-B, and the DISPLAY switch to 2 FIELD. Adjust C506 for minimum vertical deflection of the one-volt composite video signal.

20. Check for Microphonics

Place the CALIBRATOR switch to 1.0, the INPUT to CAL, the GAIN switch to LOW and turned fully counterclockwise, and the DISPLAY switch set to 2 LINE. Observe the calibrator waveform for microphonics from the fan; there should not be any. Rap the front panel lightly with the palm of the hand and check for microphonics. Microphonics of the damped ringing type should not exist; any other type of microphonics should not exceed 2 millimeters in amplitude.

21. Check Vertical Balance

Place the INPUT switch to A-B and disconnect R430 from L421. Short the two vertical crt deflection-plate leads together, being careful not to short either of them to ground. This will determine the electrical center of the crt. Note the position of the electrical center, and remove the short between the two deflection plate leads. With the vertical POSITION control, position the trace to the electrical center of the crt.

Check the vertical balance as follows. If any stage is outside the limits, usually replacing the tubes will cure the unbalance. However, the vertical amplifier will have to be recalibrated.

Vertical Balance Procedure

Short Between	Deviation From Previous Stage
Pin 2—V464 and Pin 2—V564	.5 cm
Pin 2 and Pin 7 of V453	.5 cm
Pin 1—V444 and Pin 1—~~V454~~ 54A	.5 cm
Pin 1—V424 and Pin 1—V524	Must be within graticule lines

Remove the short from pin 1 of V424 and pin 1 of V524, and reconnect R430.

22. Adjust Vertical Dc Balance

With the INPUT switch set to A-B, position the trace to the 0 IRE graticule line with the vertical POSITION control. With the GAIN control switched to low, rotate the GAIN control through its variable range without causing it to switch to HIGH. Adjust DC BAL control (R432) for minimum vertical trace shift as the GAIN control is rotated through its variable range.

Disconnect the one volt of composite video applied to the upper VIDEO INPUTS A connector and the coaxial cable between the lower VIDEO INPUTS A and B connectors.

23. Check Vertical Compression and Expansion

Place the INPUT switch to A, and apply a 10-kc signal from a Type 105 to a VIDEO INPUTS A connector. Use the amplitude control on the Type 105 and the GAIN control on the Type RM527 to adjust the square-wave amplitude display on the Type RM527 so it is 40 IRE units high. Use the vertical POSITION control to center the square wave around the 30 IRE graticule line, and again check for display 40 IRE units high. If the display is not 40 IRE units high, readjust the Type 105 and Type RM527 controls to achieve the 40 IRE units amplitude.

With the vertical POSITION, place the top of the square-wave display to the 100 IRE graticule line. Check the compression or expansion of the display; 1 millimeter maximum. Now, move the display so the bottom of the square wave is on the —40 IRE graticule line. Again check for compression or expansion of the display; the tolerance is the same. Disconnect the Type 105 from the VIDEO INPUTS A connector.

24. Check Vertical Sensitivity

Place the DISPLAY switch to VIT, and set the GAIN switch to high and leave the knob rotated fully clockwise. Apply 50 millivolts of 1-kc square wave to a VIDEO INPUTS A connector. The 50 millivolts may be obtained from the test oscilloscope or from the Type 105. If the Type 105 is used, external attenuation will be needed. Insert this attenuation between the Type 105 and the coaxial cable. Do not insert anything between the coaxial cable and the Type RM527 as this will cause erroneous reading.

With the 50 millivolts applied, check the display amplitude for at least 20 IRE units. Also check the HIGH neon to insure that it is lit. Now, switch the GAIN knob to LOW and leave it fully counterclockwise. Change the input

square-wave signal amplitude to 0.5 volt. Check the display amplitude; it should not be more than 30 IRE units. Also check the LOW neon to make sure it is lit.

Place the INPUT switch to CAL, and set the CALIBRATOR switch to 1.0. Place the bottom of the calibrator waveform on the 0 IRE graticule line. Now change the GAIN switch from LOW and fully counterclockwise to HIGH and fully clockwise, and note the shift in the bottom of the calibrator waveform. The shift should not exceed 1 centimeter. Remove the input connection to the VIDEO INPUTS A connector.

25. Adjust and Check Vertical Bandpass

Place the DISPLAY switch to 2 FIELD, the INPUT switch to A, and the GAIN switch to HIGH and rotated fully clockwise. Connect the output of a Type 190B to the lower VIDEO INPUTS A connector. Connect a 75-ohm single-ended type termination to the upper VIDEO INPUTS A connector. Set the controls of the test oscilloscope as follows:

Mode	Free run
Slope	+
Coupling	Ac
Source	Internal
Time/div	.1 mSec
Input Selector	Ac
Volts/div	0.05 volt

Connect a 10×probe from the test oscilloscope to the point at which the center conductors of the VIDEO INPUTS A connectors tie to switch SW404. Connect a lead from the + gate connector on the test oscilloscope to one of the EXT NEG SYNC INPUT connectors on the Type RM527.

Adjust the Type 190B for an output frequency of 5 mc and an output amplitude of about 100 IRE units. Center the display on the crt and proceed with the remaining adjustments in the table below.

Vertical Bandpass Table

RESPONSE Switch	SYNC Switch	Type 190B Freq.	Check or Adjust	Display to be Observed
FLAT	EXT	5 mc	L442 L542 L421 L521	Adjust each adjustment for maximum display amplitude.
FLAT	INT	50 kc	Setting Type 190B	Adjust Type 190B for a display of exactly 5 cm.
FLAT	EXT	5 mc	L462 L562	Adjust coils for maximum amplitude and then check amplitude for 5 cm ±1 mm.
FLAT	EXT	825 kc	Check	Display amplitude should be 5 cm ±1 mm.
FLAT	EXT	1.9 mc	Check	Display amplitude should be 5 cm ±1 mm.
FLAT	EXT	4.5 mc	Check	Display amplitude should be 5 cm ±1 mm.
FLAT	EXT	9 mc	Check	Display amplitude must be at least 3.5 cm.
IRE	INT	50 kc	Setting Type 190B	Adjust Type 190B for a display of exactly 5 cm.
IRE	EXT	350 kc	Check	Display amplitude should be 5 cm ±1 mm.
IRE	EXT	1 mc	Check	Display amplitude must be at least 3.5 cm.
IRE	EXT	3.6 mc	Check	Display amplitude must not exceed 5 mm.

26. Adjust RGB Separation and RGB Symmetry Controls (R349, R346) Applies to Instruments Above S/N 1189

Reset the Type RM527 controls as follows:

Crt Controls	
INTENSITY	As is
FOCUS	As is
SCALE ILLUM	As is

Vertical Controls

INPUT	B
RESPONSE	FLAT
GAIN	Switched to LOW and control rotated fully clockwise but not switched into HIGH
POSITION	Fully clockwise

Horizontal Controls

POSITION	Trace centered
MAGNIFIER	×1
SYNC	INT
DISPLAY	2 LINE

Other Controls

CALIBRATOR	As is

Connect a one-volt composite video signal to a VIDEO INPUTS A connector, and a three-level staircase generator to the HORIZ INPUT (CPXR INPUT) connector. Place the INPUT switch to A and the DISPLAY switch to RGB FIELD.

Adjust the RGB SEP control (R349) for 10 centimeters from the start of the first field to the stop of the third field. Adjust RGB SYM control (R346) so the center of the second field is equidistant from the stop of the first field to the start of the third field.

Place the DISPLAY switch to RGB LINE and check for a 10-centimeter wide display from the start of the first line to the stop of the third line. Also, check to see that the second line is equidistant from the stop of the first line to the start of the third line.

IMPORTANT

To improve operation of the "RGB LINE" display, a Zener diode has been added to the circuit of V343A. Its function is to symmetrically limit the 20-cps 3-level switching waveform to ±6 volts amplitude, thus removing any waveform oberrations, i.e., tilt or noise.

Where any other type of signal is to be connected to the external HORIZ input, this Zener diode should be removed. Four-level switching waveforms specifically must have the diode removed.

SECTION 6
PARTS LIST and DIAGRAMS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

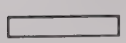
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

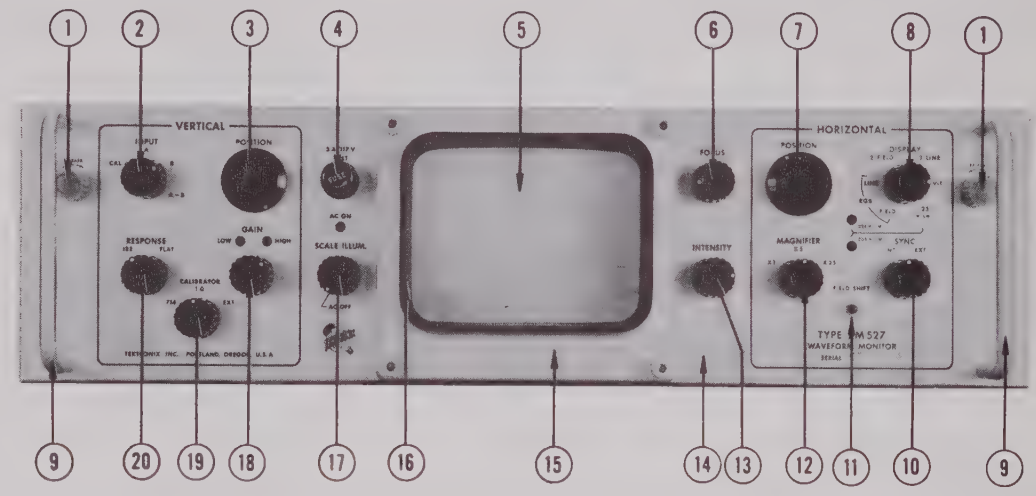
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

FRONT



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	366-061			2	KNOB, small gray
	- - - -			-	each includes:
	213-020			1	SCREW, set, 6-32 x 1/8 inch HHS
2	366-044			1	KNOB, INPUT, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-392	101	398	1	SWITCH, INPUT, wired
	- - - -			-	includes:
	260-370			1	SWITCH, unwired
	262-517	399		1	SWITCH, INPUT, wired
	- - - -			-	includes:
	260-479			1	SWITCH, unwired
	- - - -			-	mounting hardware: (not included)
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
3	366-028			1	KNOB, POSITION, large black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - -			-	mounting hardware for pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-207			1	LUG, solder, 3/8 inch

FRONT *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
4	352-002			1	HOLDER, fuse, assembly
	- - - -			-	includes:
	352-010			1	HOLDER, fuse
	200-015			1	CAP, fuse
	210-873			1	WASHER, rubber, 1/2 ID x 11/16 inch OD
	- - - -			1	NUT, fuse holder
5	331-068			1	GRATICULE, plexiglas
6	366-066	101	829	1	KNOB, FOCUS, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	366-044	830		1	KNOB, FOCUS, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - -			-	mounting hardware for pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
7	366-028			1	KNOB, POSITION, large black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - -			-	mounting hardware for pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-207	101	541X	1	LUG, solder, 3/8 inch
8	366-044			1	KNOB, DISPLAY, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-394	101	979	1	SWITCH, DISPLAY, wired
	- - - -			-	includes:
	260-371	101	979	1	SWITCH, unwired
	262-581	980	1189	1	SWITCH, DISPLAY, wired
	262-645	1190		1	SWITCH, DISPLAY, wired
	- - - -			-	includes:
	260-562			1	SWITCH, unwired
	- - - -			-	mounting hardware: (not included)
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
9	367-022			2	HANDLE
	- - - -			-	mounting hardware for each: (not included)
	213-090			2	SCREW, 10-32 x 1/2 inch HHS
10	366-044	X151		1	KNOB, SYNC., small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	260-212	101	150	1	SWITCH, SYNC., slide
	- - - -			-	mounting hardware: (not included)
	211-023			2	SCREW, 4-40 x 1/4 inch FHS
	210-406			2	NUT, hex, 4-40 x 3/16 inch

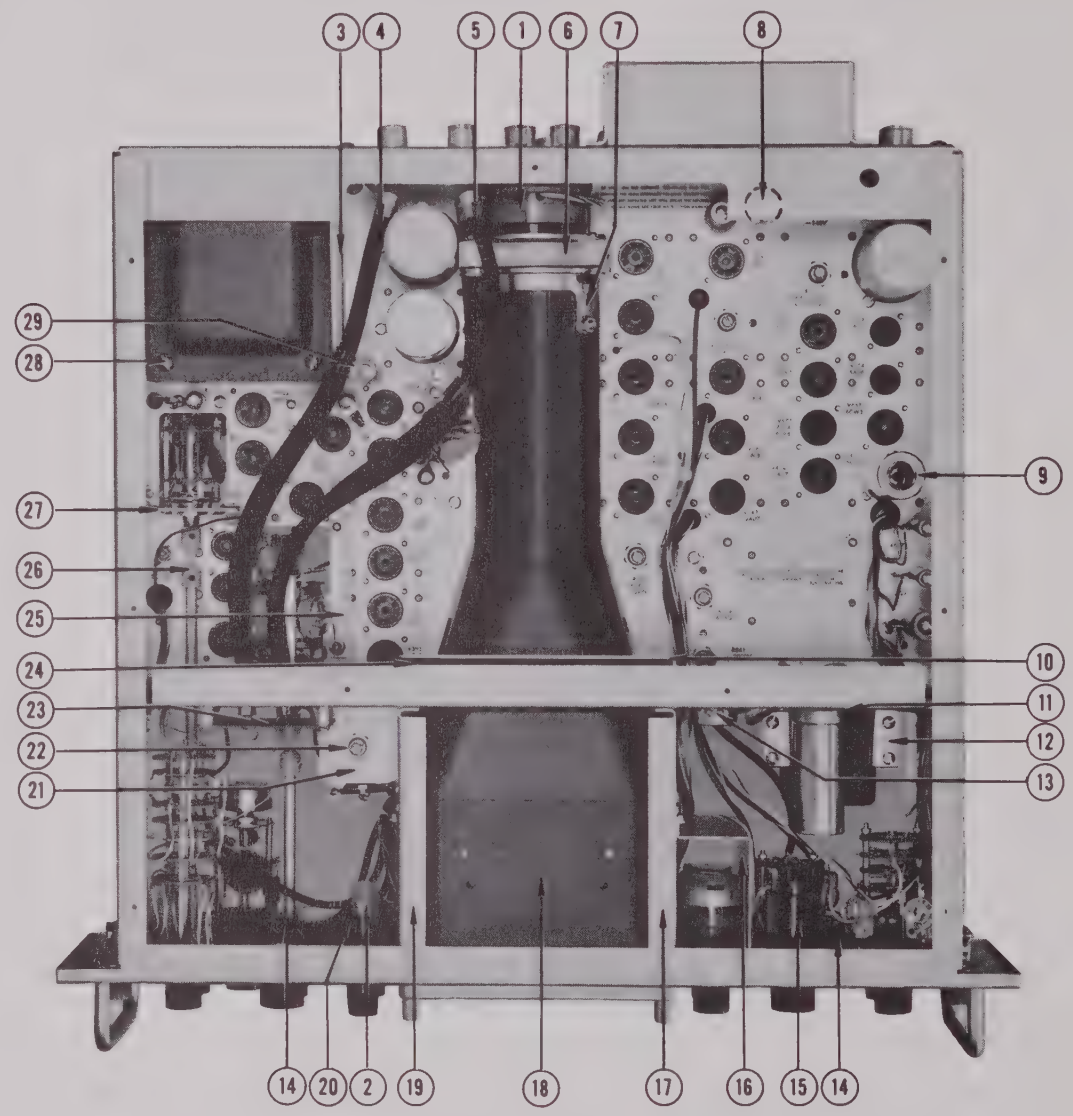
FRONT *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
	260-122	151		1	SWITCH, SYNC., rotary, unwired
	- - - -			-	mounting hardware: (not included)
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
11	260-016	101	150	1	SWITCH, FIELD SHIFT, push button
	260-247	151		1	SWITCH, FIELD SHIFT, push button
	- - - -			-	mounting hardware: (not included)
	210-465			1	NUT, hex, 1/4-32 x 3/8 inch
12	366-044			1	KNOB, MAGNIFIER, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-422	101	1034	1	SWITCH, MAGNIFIER, wired
	262-625	1035	1159	1	SWITCH, MAGNIFIER, wired
	262-642	1160		1	SWITCH, MAGNIFIER, wired
	- - - -			-	each includes:
	260-374			1	SWITCH, unwired
	- - - -			-	mounting hardware: (not included)
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
13	366-066	101	829	1	KNOB, INTENSITY, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	366-044	830		1	KNOB, INTENSITY, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - -			-	mounting hardware for pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
14	333-636	101	150	1	PANEL, front
	333-653	151		1	PANEL, front
	387-364	101	150	1	PLATE, front sub-panel
	387-403	151		1	PLATE, front sub-panel
15	200-272	101	509	1	COVER, graticule
	- - - -			-	mounting hardware: (not included)
	210-434			4	NUT, knurled, graticule
	200-409	510		1	COVER, graticule, assembly
	- - - -			-	includes:
	200-405			1	COVER, graticule
	101-005			1	TRIM, graticule cover
	- - - -			-	mounting hardware: (not included)
	210-571			4	NUT, graticule cover, 10-32 x 3/8 inch
	210-844			4	WASHER, neoprene, 7/32 ID x 3/8 inch OD

FRONT *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
16	124-142	100	1789	1	STRIP, felt (not shown)
	124-167	1790		1	STRIP, neoprene (not shown)
17	366-044			1	KNOB, SCALE ILLUM., small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - -			-	mounting hardware for pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-207			1	LUG, solder, 3/8 inch
18	366-044			1	KNOB, GAIN, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-389	101	1159	1	SWITCH, GAIN, wired
	262-641	1160		1	SWITCH, GAIN, wired
	- - - -			-	includes:
	337-416			1	SHIELD, switch, gain
	- - - -			-	mounting hardware for pot:
	210-406			2	NUT, hex, 4-40 x 3/16 inch
	210-004			2	LOCKWASHER, internal, #4
	260-372			1	SWITCH, unwired
	- - - -			-	mounting hardware: (not included)
	210-413			2	NUT, hex, 3/8-32 x 1/2 inch
	210-840			2	WASHER, .390 ID x 9/16 inch OD
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	358-029			1	BUSHING, hex, 3/8-32 x 13/32 inch
19	366-044			1	KNOB, CALIBRATOR, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-390			1	SWITCH, CALIBRATOR, wired
	- - - -			-	includes:
	- - - -			-	mounting hardware for pot:
	210-413			2	NUT, hex, 3/8-32 x 1/2 inch
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	260-373			1	SWITCH, unwired
	- - - -			-	mounting hardware: (not included)
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
20	366-044			1	KNOB, RESPONSE, small black
	- - - -			-	includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-391	101	331	1	SWITCH, RESPONSE, wired
	262-443	332		1	SWITCH, RESPONSE, wired
	- - - -			-	includes:
	260-375			1	SWITCH, unwired
	- - - -			-	mounting hardware: (not included)
	210-413			2	NUT, hex, 3/8-32 x 1/2 inch
	210-840			2	WASHER, .390 ID x 9/16 inch OD
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	358-029			1	BUSHING, hex, 3/8-32 x 13/32 inch

TOP



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	179-515			1	CABLE HARNESS, crt socket
	- - - -			-	includes:
	136-104			1	SOCKET, crt, assembly
	- - - -			-	includes:
	136-117			1	SOCKET, crt
	131-178			9	CONNECTOR, cable end, crt pin
	354-049	101	150	1	RING, securing, fiber
	- - - -			-	mounting hardware: (not included)
	213-034			2	SCREW, thread cutting, 4-40 x 5/16 inch RHS phillips

TOP *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
	387-393	151		1	PLATE, back, crt socket
	- - - -			-	mounting hardware: (not included)
	213-086			2	SCREW, thread cutting, 2-32 x 7/16 inch PHS phillips
2	200-237			1	COVER, insulation, fuse holder
3	406-679			1	BRACKET, transformer mounting
	- - - -			-	mounting hardware: (not included)
	212-004			4	SCREW, 8-32 x 5/16 inch BHS
	210-804			2	WASHER, 8S x 3/8 inch
4	175-151			2	CABLE, input coaxial, assembly, 13 1/8 inches
5	175-150			2	CABLE, input coaxial, assembly, 13 5/8 inches
6	343-071	101	844	1	CLAMP, crt, assembly
	- - - -			-	mounting hardware: (not included)
	211-504			6	SCREW, 6-32 x 1/4 inch BHS
	210-457			2	NUT, keps, 6-32 x 5/16 inch
	212-548			1	SCREW, 10-32 x 7/8 inch BHS
	210-501			1	NUT, square, 10-32 x 3/8 inch
	354-147	845	989	1	RING, clamping
	354-212	990		1	RING, crt clamping, assembly
	- - - -			-	includes:
	354-211			1	RING, clamping
	124-160			1	STRIP, liner, crt clamp
	- - - -			-	mounting hardware: (not included)
	211-560			1	SCREW, 6-32 x 1 inch RHS
	210-407			1	NUT, hex, 6-32 x 1/4 inch
	211-576			2	SCREW, 6-32 x 7/8 inch socket head
	210-949			2	WASHER, 9/64 ID x 1/2 inch OD
	214-411			1	NUT, securing
7	406-730	X845		1	BRACKET, parallax adjusting
	- - - -			-	mounting hardware: (not included)
	211-534			4	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-803			4	WASHER, 6L x 3/8 inch
	210-457			4	NUT, keps, 6-32 x 5/16 inch
8	214-210			1	SPOOL, solder, assembly
	- - - -			-	includes:
	214-209			1	SPOOL, solder
	- - - -			-	mounting hardware: (not included)
	361-007			1	SPACER, nylon, .063 inch
9	337-009			1	SHIELD, tube
10	406-678			1	BRACKET, delay line
	- - - -			-	mounting hardware: (not included)
	212-023			2	SCREW, 8-32 x 3/8 inch BHS
	210-458			2	NUT, keps, 8-32 x 11/32 inch

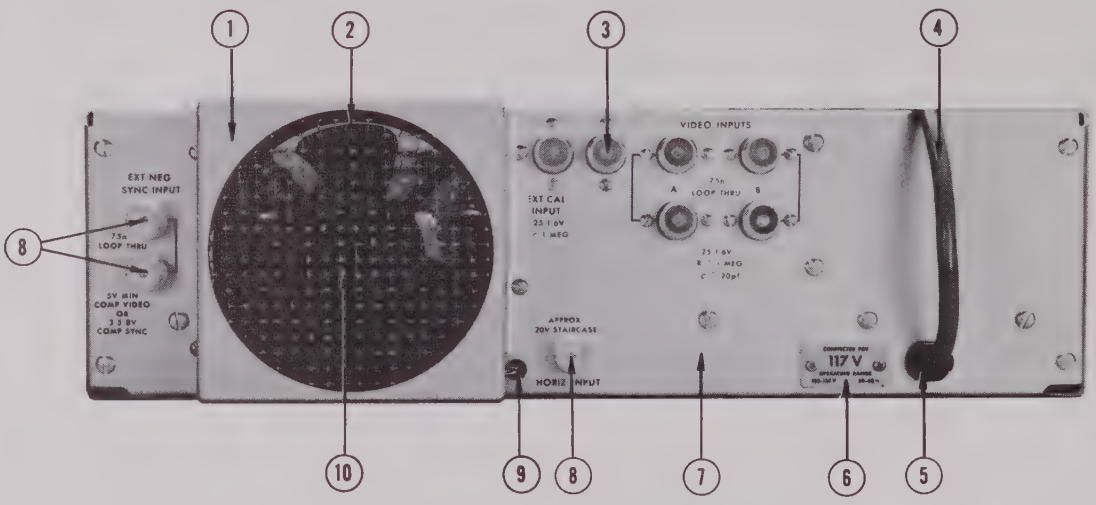
TOP *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
11	386-253			1	PLATE, metal, small capacitor
	- - - -			-	mounting hardware: (not included)
	211-534			2	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-006			2	LOCKWASHER, internal, #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
12	406-673			2	BRACKET, high voltage transformer
	- - - -			-	mounting hardware for each: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
	210-006			2	LOCKWASHER, internal, #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
13	129-006			2	POST, connecting, insulated
	- - - -			-	mounting hardware for each: (not included)
	210-006			1	LOCKWASHER, internal, #6
	210-407			1	NUT, hex, 6-32 x 1/4 inch
14	352-006			2	HOLDER, neon, double
	- - - -			-	mounting hardware for each: (not included)
	211-031			1	SCREW, 4-40 x 1 inch FHS
	210-406			2	NUT, hex, 4-40 x 3/16 inch
15	200-263	101	541X	1	COVER, dust, pot
16	337-415			1	SHIELD, focus and intensity
	- - - -			-	mounting hardware: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
	210-457			2	NUT, keps, 6-32 x 5/16 inch
17	406-672			1	BRACKET, crt shield, right
	- - - -			-	mounting hardware: (not included)
	211-538			2	SCREW, 6-32 x 5/16 inch FHS phillips
	212-070			2	SCREW, 8-32 x 5/16 inch FHS phillips
	210-458			2	NUT, keps, 8-32 x 11/32 inch
18	337-405			1	SHIELD, crt
	- - - -			-	mounting hardware: (not included)
	211-507			8	SCREW, 6-32 x 5/16 inch BHS
	210-803			6	WASHER, 6L x 3/8 inch
	210-457			8	NUT, keps, 6-32 x 5/16 inch
19	406-671			1	BRACKET, crt shield, left
	- - - -			-	mounting hardware: (not included)
	211-538			2	SCREW, 6-32 x 5/16 inch FHS phillips
	212-070			2	SCREW, 8-32 x 5/16 inch FHS phillips
	210-458			2	NUT, keps, 8-32 x 11/32 inch
20	352-008			1	HOLDER, neon, single
	- - - -			-	mounting hardware: (not included)
	211-031			1	SCREW, 4-40 x 1 inch FHS
	210-407			2	NUT, hex, 4-40 x 3/16 inch

TOP *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
21	406-699	X151		1	BRACKET, beam rotator pot
	- - - -			-	mounting hardware: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
	210-006			2	LOCKWASHER, internal, #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
22	- - - -			-	mounting hardware for pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
23	387-372	101	398	1	PLATE, printed circuit
	- - - -			-	mounting hardware: (not included)
	211-507			4	SCREW, 6-32 x 5/16 inch BHS
	210-006			3	LOCKWASHER, internal, #6
	210-202			1	LUG, solder, SE #6
	210-407			4	NUT, hex, 6-32 x 1/4 inch
	388-530	399		1	BOARD, etched circuit, coaxial terminating
	388-531	399		1	BOARD, etched circuit, coaxial matching plate
	- - - -			-	mounting hardware: (not included)
	211-507			4	SCREW, 6-32 x 5/16 inch BHS
	385-079			4	ROD, hex
	211-503			4	SCREW, 6-32 x 3/16 inch BHS
24	119-015	101	1079	1	DELAY LINE, fixed delay time
	119-027	1080		1	DELAY LINE, fixed delay time
25	337-417			1	SHIELD, vertical switch, upper
	- - - -			-	mounting hardware: (not included)
	210-457			2	NUT, keps, 6-32 x 5/16 inch
26	376-011			1	COUPLING, insulating
	- - - -			-	includes:
	213-048			2	SCREW, set, 4-40 x 1/8 inch HSS
27	406-670			1	BRACKET, switch
	- - - -			-	mounting hardware: (not included)
	211-510			2	SCREW, 6-32 x 3/8 inch BHS
	210-803			6	WASHER, 6L x 3/8 inch
	210-457			2	NUT, keps, 6-32 x 5/16 inch
28	- - - -			-	mounting hardware for transformer:
	212-523			4	SCREW, 10-32 x 2 3/4 inches HHS
	210-812			4	WASHER, fiber, #10
	210-010			4	LOCKWASHER, internal, #10
	210-564			4	NUT, hex, 10-32 x 3/8 inch
29	343-004			4	CLAMP, cable, 5/16 inch
	- - - -			-	mounting hardware for each: (not included)
	211-510			1	SCREW, 6-32 x 3/8 inch BHS
	210-803			1	WASHER, 6L x 3/8 inch

REAR

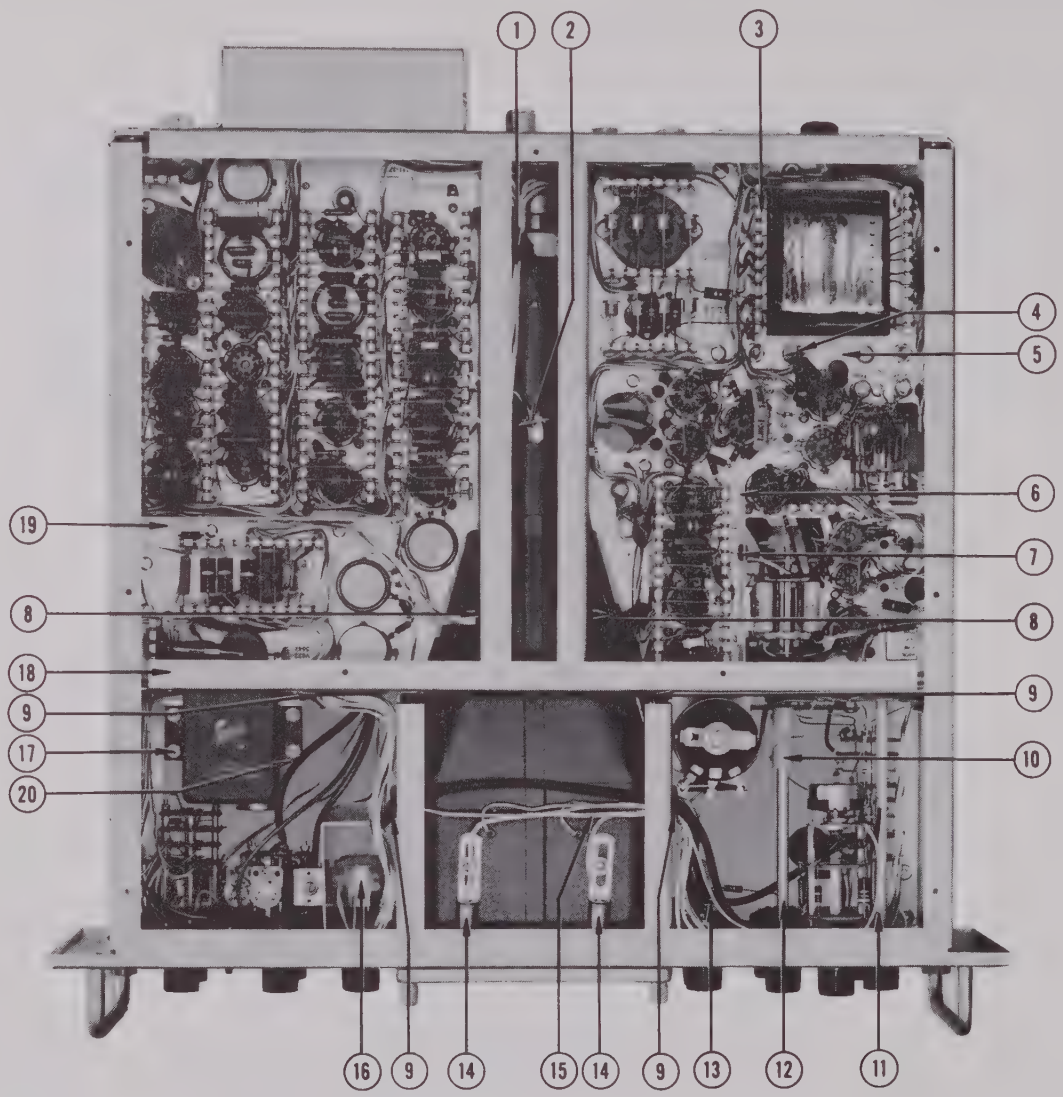


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	337-418			1	SHIELD, fan housing
	- - - -			-	mounting hardware: (not included)
	211-504			4	SCREW, 6-32 x 1/4 inch BHS
2	378-760	X151		1	SCREEN, wire cloth
3	131-081	101	369	6	CONNECTOR, chassis mounted, 1 contact, female
	- - - -			-	mounting hardware for each: (not included)
	210-241			1	LUG, ground
	358-097			2	BUSHING, insulator
	131-064	370		6	CONNECTOR, chassis mounted, coaxial
	- - - -			-	mounting hardware for each: (not included)
	211-012			2	SCREW, 4-40 x 3/8 inch BHS
	210-224			1	LUG, solder, #10, non-locking
	210-812			2	WASHER, fiber, #10
	210-004			2	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
	406-244			1	BRACKET, nylon, insulator
4	161-017			1	CORD, power
5	358-025			1	BUSHING, nylon
6	334-649			1	TAG, voltage rating
	- - - -			-	mounting hardware: (not included)
	213-035			2	SCREW, thread cutting, 4-40 x 1/4 inch PHS phillips

REAR *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
7	387-365	101	150	1	PLATE, rear
	387-402	151	369	1	PLATE, rear
	387-623	370	979	1	PLATE, rear
	387-830	980		1	PLATE, rear
	- - - -			-	mounting hardware: (not included)
	212-004			8	SCREW, 8-32 x 5/16 inch BHS
	212-070			1	SCREW, 8-32 x 5/16 inch FHS phillips
8	131-081			3	CONNECTOR, chassis mounted, 1 contact, female
9	348-002			1	GROMMET, 1/4 inch
10	119-013	101	829	1	BLOWER, assembly, fan
	119-026	830		1	BLOWER, assembly, fan
	- - - -			-	mounting hardware: (not included)
	211-513			4	SCREW, 6-32 x 5/8 inch BHS
	210-457			4	NUT, keps, 6-32 x 5/16 inch

BOTTOM

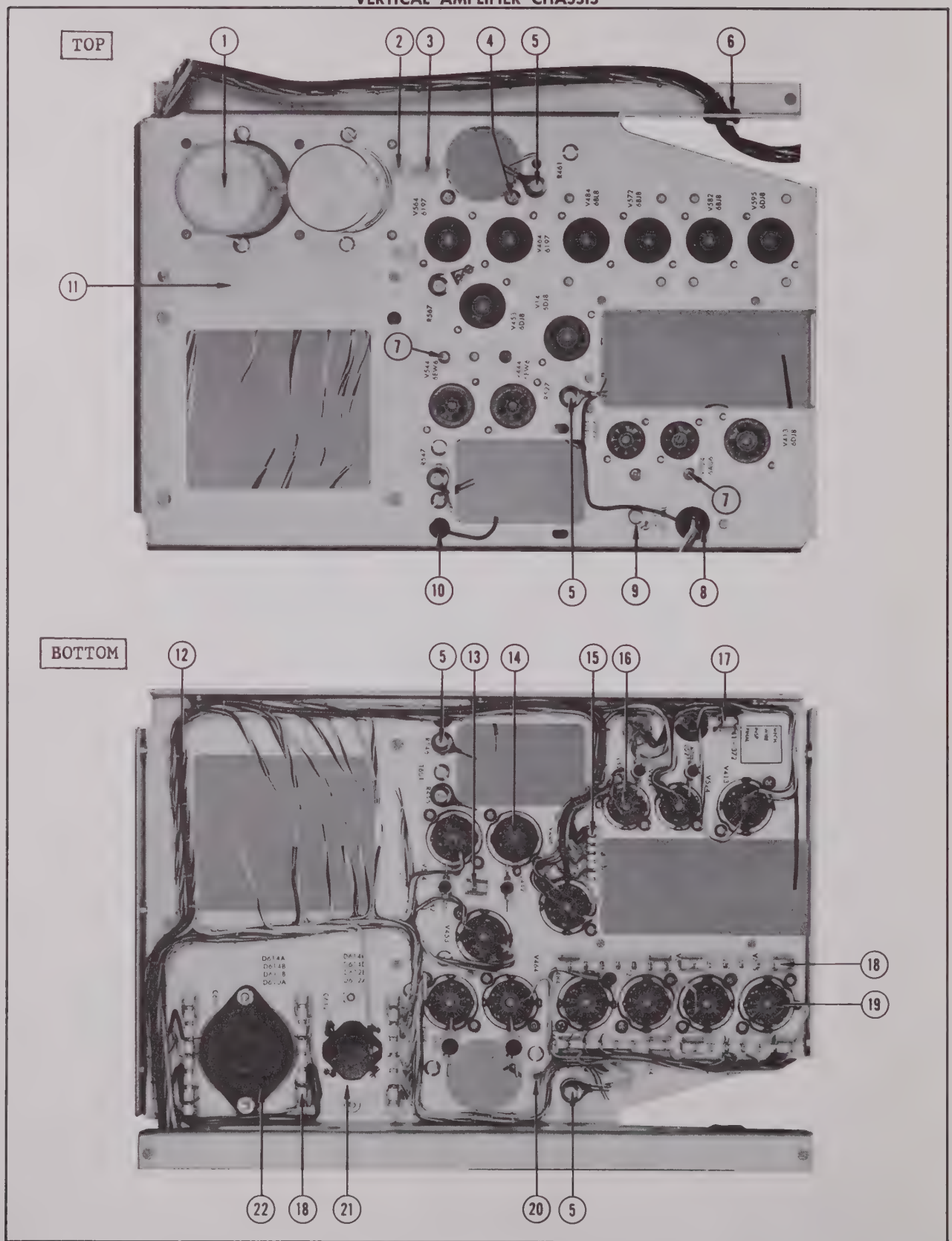


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	119-014			1	DELAY LINE, fixed, coaxial cable
2	175-585			1	WIRE, crt lead, .290 foot, stripped brown with connector
	175-593			1	WIRE, crt lead, .333 foot, stripped blue with connector
	175-587			1	WIRE, crt lead, .500 foot, stripped red with connector
	175-591			1	WIRE, crt lead, .417 foot, stripped green with connector
3	124-091			2	STRIP, ceramic, 3/4 inch x 11 notches
	- - - -			-	each includes:
	355-046			2	STUD, nylon
	- - - -			-	mounting hardware for each: (not included)
	361-008			2	SPACER, nylon, .188 inch

BOTTOM *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
4	124-100	X542		1	STRIP, ceramic, 3/4 inch x 1 notch
	- - - -			-	includes:
	355-046			1	STUD, nylon
	- - - -			-	mounting hardware: (not included)
	361-008			1	SPACER, nylon, .188 inch
5	386-645			1	PLATE, transformer
6	337-412			1	SHIELD, vertical switch
	- - - -			-	mounting hardware: (not included)
	210-457			2	NUT, keps, 6-32 x 5/16 inch
7	348-002			1	GROMMET, 1/4 inch
8	348-005			5	GROMMET, 1/2 inch
9	348-012			4	GROMMET, 5/8 inch
10	376-011			1	COUPLING, insulating
	- - - -			-	includes:
	213-048			2	SCREW, set, 4-40 x 1/8 inch HSS
11	384-581			1	ROD, shaft, extension, 8 3/4 inches
12	384-582			1	ROD, shaft, extension, 4 15/16 inches
13	200-152	101	399X	1	COVER, pot and switch, (not shown)
14	136-001	101	150	2	SOCKET, graticule lamp
	136-112	151		2	SOCKET, graticule lamp
	- - - -			-	mounting hardware for each: (not included)
	211-534			1	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-803			1	WASHER, 6L x 3/8 inch
	210-457			1	NUT, keps, 6-32 x 5/16 inch
15	179-516	101	150	1	CABLE HARNESS, beam rotator
	179-532	151		1	CABLE HARNESS, beam rotator
16	200-269			2	COVER, pot
17	- - - -			-	mounting hardware for high voltage transformer:
	211-507			4	SCREW, 6-32 x 5/16 inch BHS
	210-006			4	LOCKWASHER, internal, #6
	210-407			4	NUT, hex, 6-32 x 1/4 inch
18	387-366	101	150	1	PLATE, bulkhead
	387-401	151		1	PLATE, bulkhead
	- - - -			-	mounting hardware: (not included)
	211-538			2	SCREW, 6-32 x 5/16 inch FHS phillips
	210-457			2	NUT, keps, 6-32 x 5/16 inch
	212-004			2	SCREW, 8-32 x 5/16 inch BHS
	210-458			2	NUT, keps, 8-32 x 11/32 inch
19	337-413			1	SHIELD, high voltage
	- - - -			-	mounting hardware: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
	210-457			2	NUT, keps, 6-32 x 5/16 inch
20	407-019	X1190		1	BRACKET, pot mounting (not shown)

VERTICAL AMPLIFIER CHASSIS



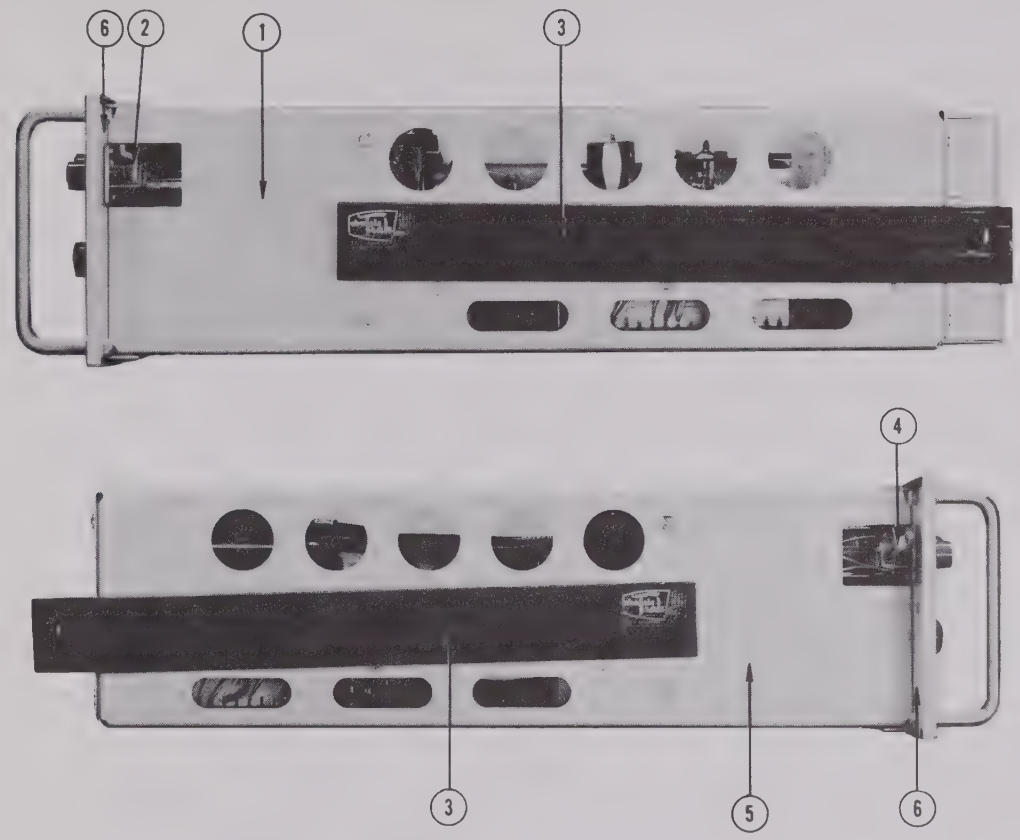
VERTICAL AMPLIFIER CHASSIS

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	200-258			1	COVER, capacitor
2	385-151			2	ROD, nylon, $2^{9}/_{16}$ inches
	- - - -			-	mounting hardware for each: (not included)
	211-507			1	SCREW, 6-32 x $^{5}/_{16}$ inch BHS
3	385-017	X845		1	ROD, nylon, $1^{5}/_{32}$ inches
	- - - -			-	mounting hardware: (not included)
	211-507			1	SCREW, 6-32 x $^{5}/_{16}$ inch BHS
4	- - - -			-	mounting hardware for each large coil:
	213-054			1	SCREW, thread cutting, 6-32 x $^{5}/_{16}$ inch PHS phillips
5	- - - -			-	mounting hardware for each 5 watt resistor:
	211-544			1	SCREW, 6-32 x $^{3}/_{4}$ inch THS phillips
	210-478			1	NUT, hex, resistor mounting
	211-507			1	SCREW, 6-32 x $^{5}/_{16}$ inch BHS
6	348-005			1	GROMMET, $^{1}/_{2}$ inch
7	- - - -			-	mounting hardware for each small coil:
	213-035			1	SCREW, thread cutting, 4-40 x $^{1}/_{4}$ inch PHS phillips
8	348-004			1	GROMMET, $^{3}/_{8}$ inch
9	- - - -			-	mounting hardware for miniature pot:
	210-583			1	NUT, hex, $^{1}/_{4}$-32 x $^{5}/_{16}$ inch
	210-046			1	LOCKWASHER, internal, .400 OD x .261 inch ID
10	348-002			1	GROMMET, $^{1}/_{4}$ inch
11	441-357	101	150	1	CHASSIS, vertical amplifier
	441-372	151		1	CHASSIS, vertical amplifier
12	179-498	101	150	1	CABLE HARNESS, vertical amplifier
	179-530	151		1	CABLE HARNESS, vertical amplifier
13	124-100			1	STRIP, ceramic, $^{3}/_{4}$ inch x 1 notch
	- - - -			-	includes:
	355-046			1	STUD, nylon
	- - - -			-	mounting hardware: (not included)
	361-009			1	SPACER, nylon, .313 inch
14	136-008	101	150	2	SOCKET, STM7G
	136-044	151		2	SOCKET, 7 pin tube
	- - - -			-	mounting hardware for each: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x $^{3}/_{16}$ inch PHS phillips
15	124-088	101	1189	1	STRIP, ceramic, $^{3}/_{4}$ inch x 4 notches
	124-149	1190		1	STRIP, ceramic, $^{7}/_{16}$ inch x 7 notches
	- - - -			-	includes:
	355-046			1	STUD, nylon
	- - - -			-	mounting hardware: (not included)
	361-009			2	SPACER, nylon, .313 inch
16	136-008			2	SOCKET, STM7G
	- - - -			-	mounting hardware for each: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x $^{3}/_{16}$ inch PHS phillips

VERTICAL AMPLIFIER CHASSIS *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
17	124-086			1	STRIP, ceramic, 3/4 inch x 2 notches
	- - - -			-	includes:
	355-046			1	STUD, nylon
	- - - -			-	mounting hardware: (not included)
	361-009			1	SPACER, nylon, .313 inch
18	124-089			7	STRIP, ceramic, 3/4 inch x 7 notches
	- - - -			-	each includes:
	355-046			2	STUD, nylon
	- - - -			-	mounting hardware for each: (not included)
	361-009			2	SPACER, nylon, .313 inch
19	136-015			9	SOCKET, STM9G
	- - - -			-	mounting hardware for each: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
20	348-031			2	GROMMET, snap-in, polyethylene
21	386-255			1	PLATE, metal, large capacitor
	- - - -			-	mounting hardware: (not included)
	211-534			2	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-006			2	LOCKWASHER, internal, #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
22	386-254			1	PLATE, fiber, large capacitor
	- - - -			-	mounting hardware: (not included)
	211-513			2	SCREW, 6-32 x 5/8 inch BHS
	166-031			2	TUBE, spacer, 1/4 inch
	210-006			2	LOCKWASHER, internal, #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch

RIGHT SIDE & LEFT SIDE

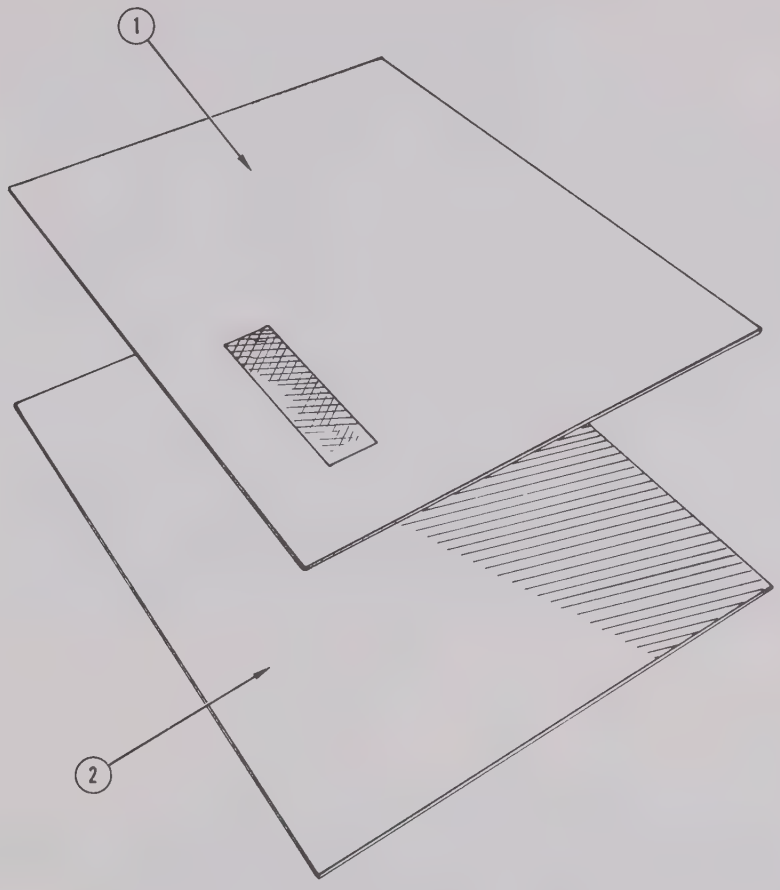


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	387-363			1	PLATE, side, right
	- - - -			-	mounting hardware: (not included)
	212-070			4	SCREW, 8-32 x 5/16 inch FHS phillips
	210-458			4	NUT, keps, 8-32 x 11/32 inch
	211-538			4	SCREW, 6-32 x 5/16 inch FHS phillips
2	214-424			1	FASTENER, pawl right, with stop
	- - - -			-	mounting hardware: (not included)
	211-038	101	150	2	SCREW, 4-40 x 5/16 inch FHS phillips
	211-025	151		2	SCREW, 4-40 x 3/8 inch FHS
	210-004			2	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
3	351-040			1	SLIDE, chassis track, 1 pair, left and right
4	214-425			1	FASTENER, pawl left, with stop
	- - - -			-	mounting hardware: (not included)
	211-038	101	150	2	SCREW, 4-40 x 5/16 inch FHS phillips
	211-025	151		2	SCREW, 4-40 x 3/8 inch FHS
	210-004			2	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch

RIGHT SIDE & LEFT SIDE *(Cont'd)*

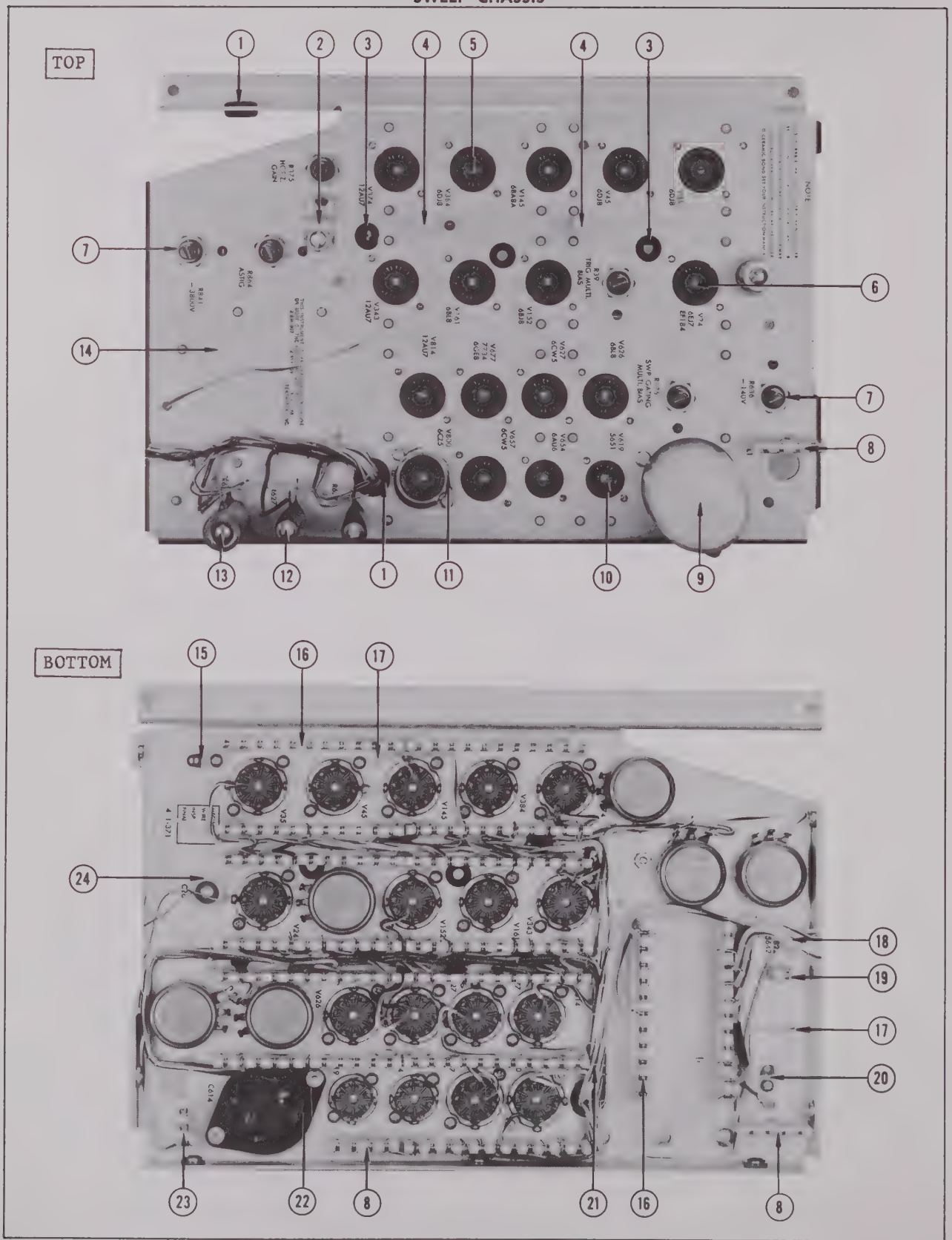
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
5	387-362			1	PLATE, side, left
	- - - -			-	mounting hardware: (not included)
	212-070			4	SCREW, 8-32 x 5/16 inch FHS phillips
	210-458			4	NUT, keps, 8-32 x 11/32 inch
	211-538			4	SCREW, 6-32 x 5/16 inch FHS phillips
6	387-415	X151		2	PLATE, spacer

CABINET



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	387-361			1	PLATE, dust cover, top
	- - - -			-	mounting hardware: (not included)
	211-538			9	SCREW, 6-32 x 5/16 inch FHS phillips
2	387-392			1	PLATE, bottom cover
	- - - -			-	mounting hardware: (not included)
	211-538			9	SCREW, 6-32 x 5/16 inch FHS phillips

SWEEP CHASSIS



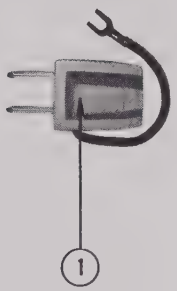
SWEEP CHASSIS

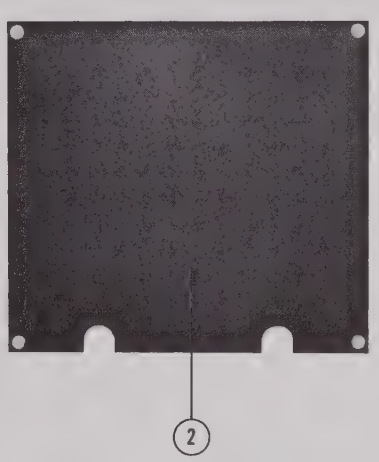
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	348-005			2	GROMMET, 1/2 inch
2	343-042			1	CLAMP, cable, 5/16 inch, half
	- - - -			-	mounting hardware: (not included)
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
	210-803			1	WASHER, 6L x 3/8 inch
	210-006			1	LOCKWASHER, internal, #6
	210-407			1	NUT, hex, 6-32 x 1/4 inch
3	348-003			3	GROMMET, 5/16 inch
4	385-138			2	ROD, delrin
	- - - -			-	mounting hardware for each: (not included)
	213-054			1	SCREW, thread cutting, 6-32 x 5/16 inch PHS phillips
5	136-015			14	SOCKET, STM9G
	- - - -			-	mounting hardware for each: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
6	136-008	101	150	1	SOCKET, STM7G
	136-044	151	1079	1	SOCKET, 7 pin
	136-015	1080		1	SOCKET, STM9G
	- - - -			-	mounting hardware: (not included)
	213-044			2	SCREW, thread cutting, 6-32 x 3/16 inch PHS phillips
7	- - - -			-	mounting hardware for each pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
8	124-088			3	STRIP, ceramic, 3/4 inch x 4 notches
	- - - -			-	each includes:
	355-046			2	STUD, nylon
	- - - -			-	mounting hardware for each: (not included)
	361-009			2	SPACER, nylon, .313 inch
9	200-258			1	COVER, capacitor
10	136-008			2	SOCKET, STM7G
	- - - -			-	mounting hardware for each: (not included)
	213-044			2	SCREW, thread cutting, 5/32 x 3/16 inch PHS phillips
11	337-005			1	SHIELD, socket
	- - - -			-	mounting hardware: (not included)
	211-033			2	SCREW, 4-40 x 5/16 inch PHS, with lockwasher
	210-004			4	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch

SWEEP CHASSIS *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
12	- - - -			-	mounting hardware for each 10 watt resistor:
	211-553			1	SCREW, 6-32 x 1½ inches RHS
	210-601			1	EYELET
	210-478			1	NUT, hex, resistor mounting
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
13	- - - -			-	mounting hardware for 20 watt resistor:
	212-037			1	SCREW, 8-32 x 1¾ inches Fil HS
	210-808	101	150	1	WASHER, centering, 20 watt resistor
	210-809	151	745	1	WASHER, centering, 25 watt resistor
	210-808	746		1	WASHER, centering, 20 watt resistor
	210-008	X151	745X	1	LOCKWASHER, internal, #8
	210-462			1	NUT, hex, resistor mounting
	212 004			1	SCREW, 8-32 x 5/16 inch BHS
14	441-356	101	150	1	CHASSIS, sweep
	441-371	151		1	CHASSIS, sweep
15	210-201			1	LUG, solder, SE #4
	- - - -			-	mounting hardware: (not included)
	213-044			1	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
16	124-091			15	STRIP, ceramic, ¾ inch x 11 notches
	- - - -			-	each includes:
	355-046			2	STUD, nylon
	- - - -			-	mounting hardware for each: (not included)
	361-009			2	SPACER, nylon, .313 inch
17	348-031			3	GROMMET, snap-in, polyethylene
18	179-499			1	CABLE HARNESS, focus and intensity
19	124-100			1	STRIP, ceramic, ¾ inch x 1 notch
	- - - -			-	includes:
	355-046			1	STUD, nylon
	- - - -			-	mounting hardware: (not included)
	361-009			1	SPACER, nylon, .313 inch
20	210-204			1	LUG, solder, DE #6
	- - - -			-	mounting hardware: (not included)
	213-044			1	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
21	179-497	101	150	1	CABLE HARNESS, sweep
	179-531	151	1189	1	CABLE HARNESS, sweep
	179-890	1190		1	CABLE HARNESS, sweep
22	386-254			1	PLATE, fiber, large capacitor
	- - - -			-	mounting hardware: (not included)
	211-513			2	SCREW, 6-32 x 5/8 inch BHS
	166-031			2	TUBE, spacer, ¼ inch
	210-006			2	LOCKWASHER, internal, #6
	210-407			2	NUT, hex, 6-32 x ¼ inch
23	124-087	X151		1	STRIP, ceramic, ¾ inch x 3 notches
	- - - -			-	includes:
	355-046			1	STUD, nylon
	- - - -			-	mounting hardware: (not included)
	361-009			1	SPACER, nylon, .313 inch
24	354-068			1	RING, securing

ACCESSORIES





REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	103-013			1	ADAPTER, power cord
2	378-525			1	FILTER, light, green

NOTES

PARTS LIST
TYPE RM527

Values are fixed unless marked variable.

Ckt. No.	S/N Range	Description					Tektronix Part Number
		Bulbs					
B338		NE-23	.025 H/CM				Use 150-027
B339		NE-23	.005 H/CM				Use 150-027
B405		NE-23				HIGH	Use 150-027
B406		NE-23				LOW	Use 150-027
B601		Incandescent #47 Grat. Light					150-001
B602		Incandescent #47 Grat. Light					150-001
B640		NE-23 Pilot Light				AC ON	Use 150-027
B847		NE-23					Use 150-027
B848		NE-23					Use 150-027
		Capacitors					
C1	101-150	4.5-25 pf	Cer.	Var.			281-010
C1	151-up	7-45 pf	Cer.	Var.			281-012
C2	101-150X	22 pf	Cer.		500 v	10%	281-511
C3		0.1 μf	PTM		200 v		285-572
C4	X-151-up	22 pf	Cer.		500 v	10%	281-511
C7	101-150X	22 pf	Cer.		500 v	10%	281-511
C10	X1190-up	.1 μf	Cer.		200 v		283-057
C11		0.1 μf	Discap		500 v		283-008
C20		.1 μf	PTM		200 v		285-572
C26		100 μf	EMT		25 v		290-015
C29	101-1189	.02 μf	Discap		600 v		283-006
C29	1190-up	.0015 μf	Discap		500 v		283-035
C34		47 pf	Cer.		500 v	10%	281-519
C37		47 pf	Cer.		500 v	10%	281-519
C44		150 pf	Cer.		500 v		281-524
C48		4.7 pf	Cer.		500 v	±1% pf	281-501
C142		18 pf	Cer.		500 v		281-558
C160A		7500 pf	Mylar		600 v	1%	*291-032
C160C	101-1189	4.5-25 pf	Cer.	Var.			281-010
C160C	1190-up	7-45 pf	Cer.	Var.			281-012
C160D	X151-1189	8 pf	Cer.		500 v	±0.5 pf	281-503
C160D	1190-up	7-45 pf	Cer.	Var.			281-012
C160E		470 pf	Mica		500 v	10%	283-522
C160G		4.5-25 pf	Cer.	Var.			281-010
C178		.001 μf	Discap		500 v		283-000
C320		4.5-25 pf	Cer.	Var.			281-010
C321		18 pf	Cer.		500 v		281-558
C331		100 pf	Cer.		500 v	10%	281-530
C332		2000 pf	Mica		500 v	1%	283-555
C333	101-1034	360 pf	Mica		500 v	±1%	283-567
C333	1035-up	270 pf	Mica		500 v	5%	283-551
C334	101-1034	4.5-25 pf	Cer.	Var.			281-010
C334	1035-up	9-180 pf	Cer.	Var.	500 v		281-023
C336		4.5-25 pf	Cer.	Var.			281-010
C341		.001 μf	Discap		500 v		283-000
C345		.005 μf	Discap		500 v		283-001
C348	101-979	3900 pf	Mica			5%	283-531
C348	980-1189	.0033 μf	Discap		150 v	5%	283-051
C348	1190-up	.006 μf	Mica		500 v	5%	283-546
C355		.01 μf	Discap		250 v		283-005
C404		12 pf	Cer.		500 v	10%	281-505

Capacitors *(continued)*

							Tektronix Part Number
C406		1.5-7 pf	Cer.	Var.			281-005
C408		.005 μf	Discap		500 v		283-001
C409		2.2 pf	Cer.		500 v	±0.5 pf	281-500
C411		.001 μf	Discap		500 v		283-000
C412		0.1 μf	PTM		200 v		285-572
C417		0.1 μf	PTM		200 v		285-572
C432	101-1189X	.001 μf	Discap		500 v		283-000
C428		.005 μf	Discap		500 v		283-001
C434	X332-up	24 pf	Cer.		500 v	5%	281-564
C435	101-331	150 pf	Cer.		500 v		281-524
C435	332-up	130 pf	Cer.		500 v	1%	283-053
C436	X332-up	24 pf	Cer.		500 v	5%	281-564
C437	101-331	150 pf	Cer.		500 v	1%	281-524
C437	332-up	130 pf	Cer.		500 v		283-053
C439	X210-1189X	.01 μf	Discap		150 v		283-003
C443		.001 μf	Discap		500 v		283-000
C448		.005 μf	Discap		500 v		283-001
C463		.001 μf	Discap		500 v		283-000
C468		.005 μf	Discap		500 v		283-001
C485		18 pf	Cer.		500 v		281-558
C504		12 pf	Cer.		500 v	10%	281-505
C506		1.5-7 pf	Cer.	Var.			281-005
C508		.005 μf	Discap		500 v		283-001
C509		2.2 pf	Cer.		500 v	±0.5 pf	281-500
C523	101-1189X	.001 μf	Discap		500 v		283-000
C539	X210-1189X	.01 μf	Discap		150 v		283-003
C543		.001 μf	Discap		500 v		283-000
C563		.001 μf	Discap		500 v		283-000
C582		100 pf	Mica			5%	283-506
C593		27 pf	Cer.		500 v	±1.35 pf	281-515
C595		.01 μf	Discap		250 v		283-005
C610		125 μf	EMC		350 v		*290-154
C612A,B		10 x 160 μf	EMC		350 v		*290-061
C614A,B		10 x 160 μf	EMC		350 v		*290-155
C621		.01 μf	PTM		400 v		285-510
C631		.01 μf	PTM		400 v		285-510
C661		.01 μf	PTM		400 v		285-510
C670A,B		2 x 10 μf	EMC		500 v		*290-152
C681		.01 μf	PTM		400 v		285-510
C803		.001 μf	Discap		500 v		283-000
C807		.001 μf	PTM		600 v		285-501
C808		900 pf	Mica		500 v	10%	283-525
C822		2500 pf	Discap		6000 v		283-036
C841		.02 μf	Discap		600 v		283-006
C842		2500 pf	Discap		6000 v		283-036
C850		.02 μf	Discap		600 v		283-006
C867		.001 μf	Discap		500 v		283-000

Diodes

D4	X151-1879	Silicon Selected from 1N622A	*152-045
D4	1880-up	Signal Replaceable by 1N3605	*152-185
D7	101-150	Germanium	152-008
D7	151-1879	Silicon Selected from 1N622A	*152-045
D7	1880-up	Signal Replaceable by 1N3605	*152-185
D14		Germanium	152-008
D16		Germanium	152-008
D19	101-150	Germanium	152-008
D19	151-1879	Silicon Selected from 1N622A	*152-045
D19	1880-up	Signal Replaceable by 1N3605	*152-185

Diodes *(continued)*

			Tektronix Part Number
D32	X1190-up	Tek Spec	*152-061
D44		Germanium	152-008
D347	X1190-up	Zener RT6	152-016
D412	X1160-up	Tek Spec	*152-075
D417	X1160-up	Tek Spec	*152-075
R443	X1190-up	Silicon 1N3605	152-141
D444		Germanium	152-007
D446		Germanium	152-007
D543	X1190-up	Silicon 1N3605	152-141
D596		Silicon 1N789	152-017
D610A,B		Silicon Replaceable by 1N2864	Use (2) *152-048
D612A,B		Silicon Replaceable by 1N2864	Use (2) *152-048
D614A,B,C,D		Silicon Replaceable by 1N2862	(4) 152-047
D882		Zener RT6	152-016

Fuses

F601		3 Amp 3 AG Fast-Blo 117 V operation	159-015
F601		1.5 Amp 3 AG Fast-Blo 234 V operation	159-016

Inductors

L1		100 mμh			*108-229
L34		Delay Line			119-014
L43	101-1079	Replacement Kit			Use *050-144
L43	1080-up	Delay Line			119-027
L400	101-398	100 μh			*108-229
L400	399-up	Part of etched circuit board			*388-531
L421		11-23 μh	Var.	core 276-506	*114-110
L434		3.2 μh			*108-088
L435		130 μh			*108-234
L436		3.2 μh			*108-088
L437		130 μh			*108-234
L442		15-30 μh	Var.	core 276-506	*114-076
L460		3.2 μh			*108-088
L462		60-115 μh	Var.	core 276-506	*114-140
L500	101-398	100 μh			*108-229
L500	399-up	Part of etched circuit board			*388-531
L505	X399-up	Ferramic suppressor			276-507
L521		11-23 μh	Var.	core 276-506	*114-110
L542		15-30 μh	Var.	core 276-511	*114-076
L560		3.2 μh			*108-088
L562		60-115 μh	Var.	core 276-511	*114-140
L860		Beam Rotator			*108-228

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R1		400 k	½ w	Prec.	1%	309-126
R3	101-150X	1.8 meg	½ w	Prec.	1%	309-020
R4	101-150	2.15 meg	½ w	Prec.	1%	309-275
R4	151-up	220 k	½ w			302-224
R7	X151-up	1.11 meg	½ w	Prec.	1%	309-015
R8	X1190-up	750 k	¼ w		5%	315-754
R9	X1190-up	680 k	¼ w		5%	315-684
R10		47 Ω	¼ w			316-470
R11		1 meg	¼ w			316-105
R13		68 k	½ w			302-683
R14		1 k	¼ w		5%	315-102
R15		22 k	1 w			303-223
R16		1 k	¼ w		5%	315-102
R17		47 Ω	¼ w			316-470
R18		68 k	½ w			302-683
R19	101-150	2.15 meg	½ w	Prec.	1%	309-275
R19	151-up	1.5 meg	½ w	Prec.	1%	309-017

Resistors *(continued)*

								Tektronix Part Number
R20		1 meg	½ w	Prec.			1%	309-148
R21		100 Ω	¼ w					316-101
R23	101-1189	4.7 k	2 w					306-472
R23	1190-up	6.8 k	2 w				5%	305-682
R25		27 Ω	½ w					302-270
R26		56 Ω	½ w					302-560
R28	X1190	100 Ω	¼ w				5%	315-101
R29	101-1189	2.2 meg	½ w					302-225
R29	1190-up	150 k	½ w				5%	301-154
R31		15 meg	½ w					Use 301-156
R32		100 Ω	¼ w					316-101
R33		2.7 k	½ w				5%	301-272
R34		2.7 k	½ w				5%	301-272
R35	X1160-up	270 Ω	Nominal Value (Selected)					301-271
R36	X980-up	6.8 k	½ w					302-682
R37		139.5 k	½ w	Prec.			1%	309-265
R38		111 k	½ w	Prec.			1%	Use 309-046
R39		50 k		Var.		Trig.	Multi. Bias	311-023
R40		18 k	2 w				5%	305-183
R41		100 Ω	¼ w					316-101
R42	X980-up	220 k	½ w					302-224
R43	101-1079	2.1 k	½ w	Prec.			1%	309-117
R43	1080-up	6.8 k	½ w				5%	301-682
R44	101-1079	40 k	½ w	Prec.			1%	309-155
R44	1080-up	120 k	½ w	Prec.			1%	309-091
R45	101-150	1.2 meg	½ w	Prec.			1%	309-149
R45	151-1079	800 k	½ w	Prec.			1%	309-110
R45	1080-up	500 k	½ w	Prec.			1%	309-003
R46		100 Ω	¼ w					316-101
R47		47 k	2 w				5%	305-473
R48		200 k	½ w	Prec.			1%	309-051
R49		72 k	1 w	Prec.			1%	310-113
R140		11 k	2 w				5%	305-113
R141		100 Ω	¼ w					316-101
R142		36 k	1 w				5%	303-363
R143		27 k	½ w				5%	301-273
R144		39 k	½ w					302-393
R145		100 Ω	¼ w					316-101
R148		56 k	2 w					306-563
R150		1 meg	½ w					302-105
R151		100 Ω	¼ w					316-101
R160		4 meg	1 w	Prec.			1%	310-103
R161		100 Ω	¼ w					316-101
R163		390 k	½ w					302-394
R164		56 k	½ w					302-563
R165		100 k	½ w					302-104
R166	X980-up	56 k	½ w					302-563
R167		100 Ω	¼ w					316-101
R168		100 Ω	¼ w					316-101
R170		45 k	1 w	Prec.			1%	310-093
R172		18 k	½ w	Prec.			1%	309-036
R173		15 k	1 w	Prec.			1%	310-115
R174	X151-1079X	18 k	¼ w					316-183
R175		27 k	½ w					302-273
R176		100 k		Var.		Swp.	Gating Multi Bias	311-026
R178		1.8 meg	½ w					302-185
R179		75 Ω	½ w				5%	301-750
R320		1.55 meg	½ w	Prec.			1%	309-018
R321		1.5 meg	½ w	Prec.			1%	309-017
R323		50 k		Var.	WW	Horiz	POSITION	Use 311-358

								Tektronix Part Number
R330		4 meg	½ w	Prec.		1%		Use 309-093
R332		25.6 k	½ w	Prec.		1%		Use 309-136
R334		150 k	½ w	Prec.		1%		Use 309-049
R338		470 k	½ w					302-474
R340		10 meg	½ w					302-106
R341		2.2 meg	¼ w					316-225
R343		100 Ω	¼ w					316-101
R344	101-1189	5.6 k	½ w					302-562
R344	1190-up	3 k	½ w			5%		301-302
R345		100 k	½ w					302-104
R346	X1190-up	5 k		Var.				311-310
R347	101-1189	62 k	½ w			5%		301-623
	1190-up	33 k	½ w			5%		301-333
R348	101-1189	16.69 k	½ w	Prec.		1%		309-231
R348	1190-up	10.1 k	½ w	Prec.		1%		309-034
R349	X1190-up	50 k		Var.				311-329
R350		100 Ω	¼ w					316-101
R353		3.3 k	½ w					302-332
R354		47 k	1 w					304-473
R355		50 k		Var.		Swp./Mag. Regis.		311-224
R370		100 Ω	¼ w					316-101
R371		100 Ω	¼ w					316-101
R372		43 k	1 w			5%		303-433
R374		68 k	½ w			5%		301-683
R375		2.25 k		Var.		Horiz. Gain		311-071
R376		68 k	½ w			5%		301-683
R378		43 k	1 w			5%		303-433
R380		100 Ω	¼ w					316-101
R381		100 Ω	¼ w					316-101
R382		51 k	1 w			5%		303-513
R384		27 k	½ w			5%		301-273
R385		3.9 k	½ w			5%		Use 301-392
R386		27 k	½ w			5%		301-273
R388		51 k	1 w			5%		303-513
R405		470 k	½ w					302-474
R406		1.5 meg	½ w	Prec.		1%		309-017
R407		1 meg	½ w	Prec.		1%		309-148
R408		470 k	½ w					302-474
R410		270 Ω	¼ w					Use 316-271
R411		100 Ω	¼ w					316-101
R412		27 k	1 w					304-273
R413		4 meg	½ w	Prec.		1%		309-093
R414		2.5 meg	½ w	Prec.		1%		309-025
R415		270 Ω	¼ w					Use 316-271
R416		100 Ω	¼ w					316-101
R417		27 k	1 w					304-273
R418		1 meg	½ w	Prec.		1%		309-148
R419		1.8 meg	½ w	Prec.		1%		309-020
R420		47 Ω	¼ w					316-470
R421		1.4 k	½ w	Prec.		1%		309-274
R423	101-1189X	220 k	¼ w					316-224
R426		1.6 k	½ w			5%		301-162
R427 †		1 k		Var.	WW	GAIN		*311-247
R428		6.8 k	1 w					304-682
R429	X1190-up	2.2 meg	¼ w					316-225
R430		120 k	½ w					302-124

† Ganged with SW405. Furnished as a Unit.

							Tektronix Part Number
R432		250 k	¾ w	Var.		DC Bal.	Use 311-374
R439	X210-1189X	47 k	½ w				302-473
R440		47 Ω	½ w				302-470
R441		6.2 k	2 w			5%	305-622
R442		1.8 k	2 w	Prec.	Mica Pl.	1%	*310-533
R443		470 k	¼ w				316-474
R444		39 Ω	½ w			5%	301-390
R445		82 Ω	½ w	(Select Nom Val)		5%	301-820
R446		8 k	5 w		WW	5%	308-007
R447	X542-up	5.6 k	1 w				304-562
R450		47 Ω	¼ w				316-470
R451		47 Ω	¼ w				316-470
R452		100 Ω	¼ w				316-101
R454		12 k	1 w				304-123
R456		12 k	1 w				304-123
R458		100 Ω	¼ w				316-101
R460		47 Ω	½ w				302-470
R461		850 Ω	5 w		WW	5%	308-187
R462		2.5 k	8 w	Prec.	Mica Pl.	1%	*310-522
R463		470 k	¼ w				316-474
R466		120 Ω	½ w			5%	301-121
R468		8 k	5 w		WW	5%	308-007
R469		4.7 k	½ w				302-472
R470		3.3 k	½ w				302-332
R471		82 k	½ w				302-823
R472	X400-1189	470 k	¼ w				316-474
R472	1190-up	43 k	½w			5%	301-433
R474		100 k		Var.		Vertical POSITION	311-026
R478		3.3 k	½ w				302-332
R480		47 Ω	¼ w				316-470
R483	101-1189	33 k	½ w			5%	301-333
	1190-up	16 k	½ w			5%	301-163
R484		68 k	½ w			5%	301-683
R485		22 k	½ w			5%	301-223
R487		100 k	1 w			5%	303-104
R506		1.5 meg	½ w	Prec.		1%	309-017
R507		1 meg	½ w	Prec.		1%	309-148
R508		470 k	½ w				302-474
R520		47 Ω	¼ w				316-470
R521		1.4 k	½ w	Prec.		1%	309-274
R523	101-1189X	220 k	¼ w				316-224
R526		1.6 k	½ w			5%	301-162
R527		3.5 k	5 w		WW	5%	308-080
R539	X210-1189X	47 k	½ w				302-473
R540		47 Ω	½ w				302-470
R542		1.8 k	2 w	Prec.	Mica Pl.	1%	*310-533
R543		470 k	¼ w				316-474
R544		39 Ω	½ w			5%	301-390
R546		8 k	5 w		WW	5%	308-007
R547	101-150	3 k	5 w		WW	5%	308-082
R547	151-up	3.5 k	5 w		WW	5%	308-080
R560		47 Ω	½ w				302-470
R562		2.5 k	8 w	Prec.	Mica Pl.	1%	*310-522
R563		470 k	¼ w				316-474
R565	X542-up	1 k	½ w				302-102
R566		120 Ω	½ w			5%	301-121

							Tektronix Part Number
R567		850 Ω	5 w		WW	±5%	308-187
R570		47 Ω	¼ w				316-470
R573		15 k	2 w				306-153
R580		47 Ω	¼ w				316-470
R583		68 k	½ w			5%	301-683
R590		27 k	½ w				302-273
R591		680 k	½ w				302-684
R592		47 Ω	¼ w				316-470
R593		9.1 k	½ w			5%	301-912
R595	101-1189	5.6 k	½ w			5%	301-562
R595	1190-up	3 k	½ w			5%	301-302
R596	101-1189	2.7 meg	½ w			5%	301-275
R596	1190-up	1 meg	½ w			5%	301-105
R597		27 k	2 w			5%	305-273
R598		47 Ω	¼ w				316-470
R599		8.2 k	½ w			5%	301-822
R601†		50 Ω		Var.	WW	SCALE ILLUM.	311-057
R610		2.7 Ω	1 w				307-007
R611		2.7 Ω	1 w				307-007
R614		4.7 Ω	1 w				307-009
R619		27 k	1 w				304-273
R620		1 meg	½ w				302-105
R621		1 k	¼ w				316-102
R622		36 k	1 w			5%	303-363
R623		1 meg	½ w				302-105
R624		1 k	¼ w				316-102
R625		1 k	¼ w				316-102
R626		1 k	1 w				304-102
R627	101-150	1.5 k	25 w		WW	5%	308-040
R627	151-up	1.5 k	10 w		WW	5%	308-055
R630		1 meg	½ w				302-105
R631		250 k	½ w	Prec.		1%	309-162
R632		400 k	1 w	Prec.		1%	310-094
R634		2 meg	½ w	Prec.		1%	309-023
R636		100 k		Var.		—140 Volts	311-026
R640		470 k	½w				302-474
R650		180 k	½ w				302-184
R651		68 k	½ w				302-683
R653		1.8 meg	½ w				302-185
R654		1 k	¼ w				316-102
R655		1 k	¼ w				316-102
R656		1 k	1 w				304-102
R657	101-150	1.5 k	25 w		WW	5%	308-040
R657	151-up	1.5 k	10 w		WW	5%	308-055
R660		470 k	½ w				302-474
R661		400 k	½ w	Prec.		1%	309-126
R662		390 k	½ w	Prec.		1%	309-056
R670		220 k	½ w				302-224
R671		39 k	½ w				302-393
R672		470 k	½ w				302-474
R673		1.8 meg	½ w				302-185
R674		1 k	¼ w				316-102
R675		1 k	¼ w				316-102

† R601 ganged with SW601. Furnished as a unit.

Resistors *(continued)*

							Tektronix Part Number
R676	101-150	500 Ω	5 w		WW		308-189
R676	151-745X	333 Ω	10 w		WW	5%	308-049
R677	101-150	2.25 k	20 w		WW	5%	308-064
R677	151-745	2 k	25 w		WW	5%	308-065
R677	746-up	2.25 k	20 w		WW	5%	308-064
R678		1 k	1 w				304-102
R679	X151-745	150 Ω	2 w				306-151
R679	746-up	47 k	2 w				306-473
R680		470 k	½ w				302-474
R681		200 k	½ w	Prec.		1%	309-051
R682		400 k	1 w	Prec.		1%	310-094
R803	101-150	47 k	2 w				Use 306-683
R803	151-up	68 k	2 w				306-683
R806	101-150	100 k	½ w				Use 302-473
R806	151-up	47 k	½ w				302-473
R807		5.6 k	½ w				302-562
R808	X190-up	220 Ω	½ w				302-221
R814		1 k	½ w				302-102
R822	X180-up	3.3 Ω	½ w				307-025
R823	X180-up	3.3 Ω	½ w				307-025
R815		470 k	½ w				302-474
R839	X300-up	1.5 meg	½ w				302-155
R840	101-299	3.3 meg	1 w				304-335
R840	300-up	1.5 meg	½ w				302-155
R841		2 meg		Var.		—3800 V	311-042
R842		8.2 meg	2 w				306-825
R843		8.2 meg	2 w				306-825
R844		6.8 meg	2 w				306-685
R845		5 meg		Var.		FOCUS	311-121
R846		4.7 meg	2 w				306-475
R847		680 k	½ w				302-684
R848		2 meg		Var.		INTENSITY	311-043
R850		33 k	½ w				302-333
R851	X151-up	1 meg	½ w				302-105
R860	101-150	2 x 1 k		Var.	WW	CRT Beam Rotator	311-007
R860	151-up	2 x 300 Ω		Var.		CRT Beam Rotator	311-250
R864		50 k		Var.		Astig.	311-023
R866		62 k	½ w			5%	301-623
R867		56 k	½ w			5%	301-563
R871		470 Ω	½ w				302-471
R875		39 k	1 w				304-393
R880		2.5 k	½ w	Prec.		1%	309-181
R882		1 k	½ w	Prec.		1%	309-115
R884		13.5 k	½ w	Prec.		1%	309-263
R886	101-150	10 k		Var.		Cal. Ampl.	311-016
R886	151-up	10 k		Var.	WW	Cal. Ampl.	311-015

Switches

				Unwired	Wired
SW7	101-150	Slide	SYNC	260-212	
	151-up	Slide	SYNC	260-122	
SW160	101-979	Rotary	DISPLAY	260-371	*262-394
SW160	980-1189	Rotary	DISPLAY	260-562	*262-581
SW160	1190-up	Rotary	DISPLAY	260-562	*262-645
SW178	101-150	Red Pushbutton	FIELD SHIFT	260-016	
	151-up	Red Pushbutton	FIELD SHIFT	260-247	
SW335		Rotary	MAGNIFIER	260-374 Use	*262-642
SW404	101-398	Rotary	INPUT	Use	*050-068
SW404	399-up	Rotary	INPUT	260-479	*262-517
SW405†		Rotary	GAIN	260-372 Use	*262-641

† Ganged with R427. Furnished as a unit.

Switches *(continued)*

				Tektronix Part Number	
				Unwired	Wired
SW434	101-331	Rotary	RESPONSE	*260-375	*050-053
SW434	332-up	Rotary	RESPONSE	*260-375	*262-443
SW601 ‡			AC OFF	311-057	
SW880		Rotary	CALIBRATOR	*260-373	*262-390

Transformers

T601	Low Voltage	*120-204
T801	High Voltage	*120-206

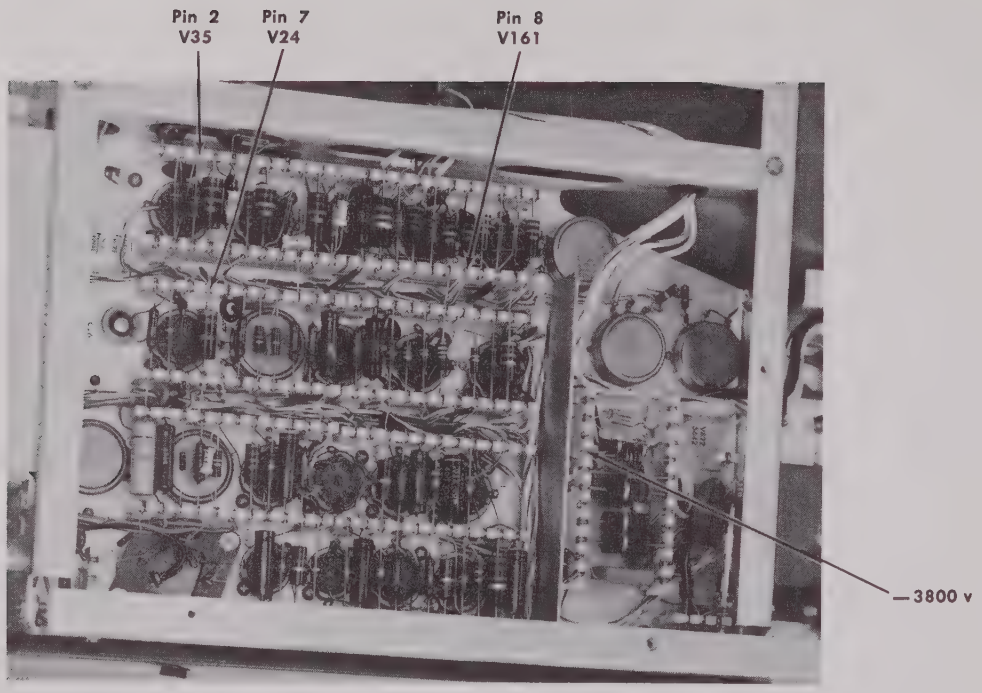
Transistor

Q874	2N394/2N1303	151-051

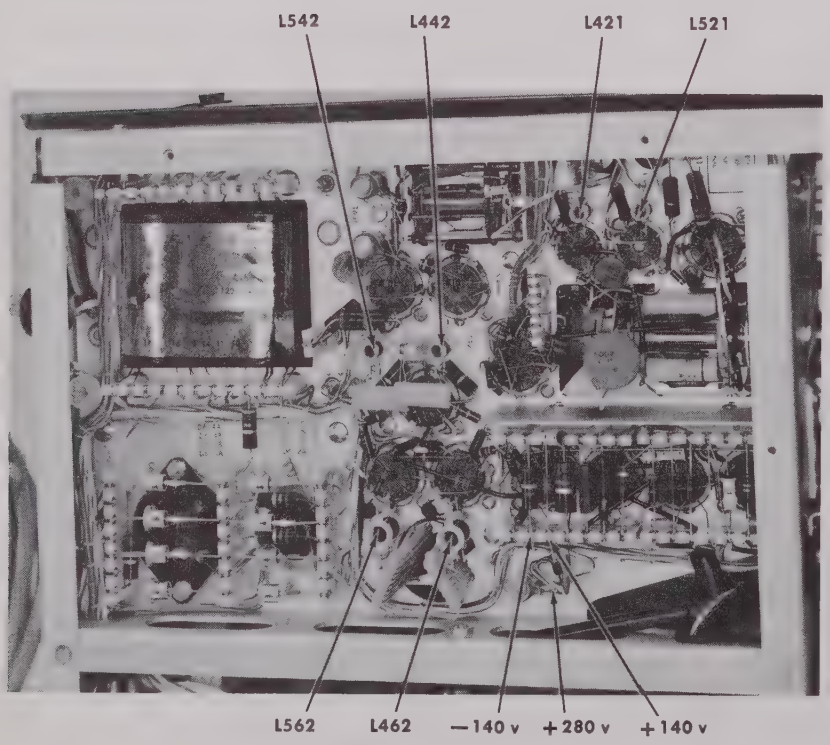
Vacuum Tubes

V14		6DJ8	154-187
V24	101-1079	6EW6	154-212
V24	1080-up	6EJ7/EF184	154-421
V35		6DJ8	154-187
V45		6DJ8	154-187
V145		6BA8A	154-163
V152		6BJ8	154-305
V161†		6BL8	154-278
V343		12AU7	154-041
V374		12AU7	154-041
V384		6DJ8	154-187
V413		6DJ8	154-187
V424†††		6AU6	Use *157-059
V444 ††		6EW6	Use *157-069
V453		6DJ8	154-187
V464		6197	154-146
V484†		6BL8	154-278
V524†††		6AU6	Use *157-059
V544 ††		6EW6	Use *157-069
V564		6197	154-146
V572		6BJ8	154-305
V582		6BJ8	154-305
V595		6DJ8	154-187
V619		5651	154-052
V626†		6BL8	154-278
V627		6CW5/EL86	154-202
V654		6AU6	154-022
V657		6CW5/EL86	154-202
V677		7734/6GE8	154-260
V800		6CZ5	154-167
V814		12AU7	154-041
V822		5642	154-051
V859		T5270-1 Standard Phosphor CRT	*154-314

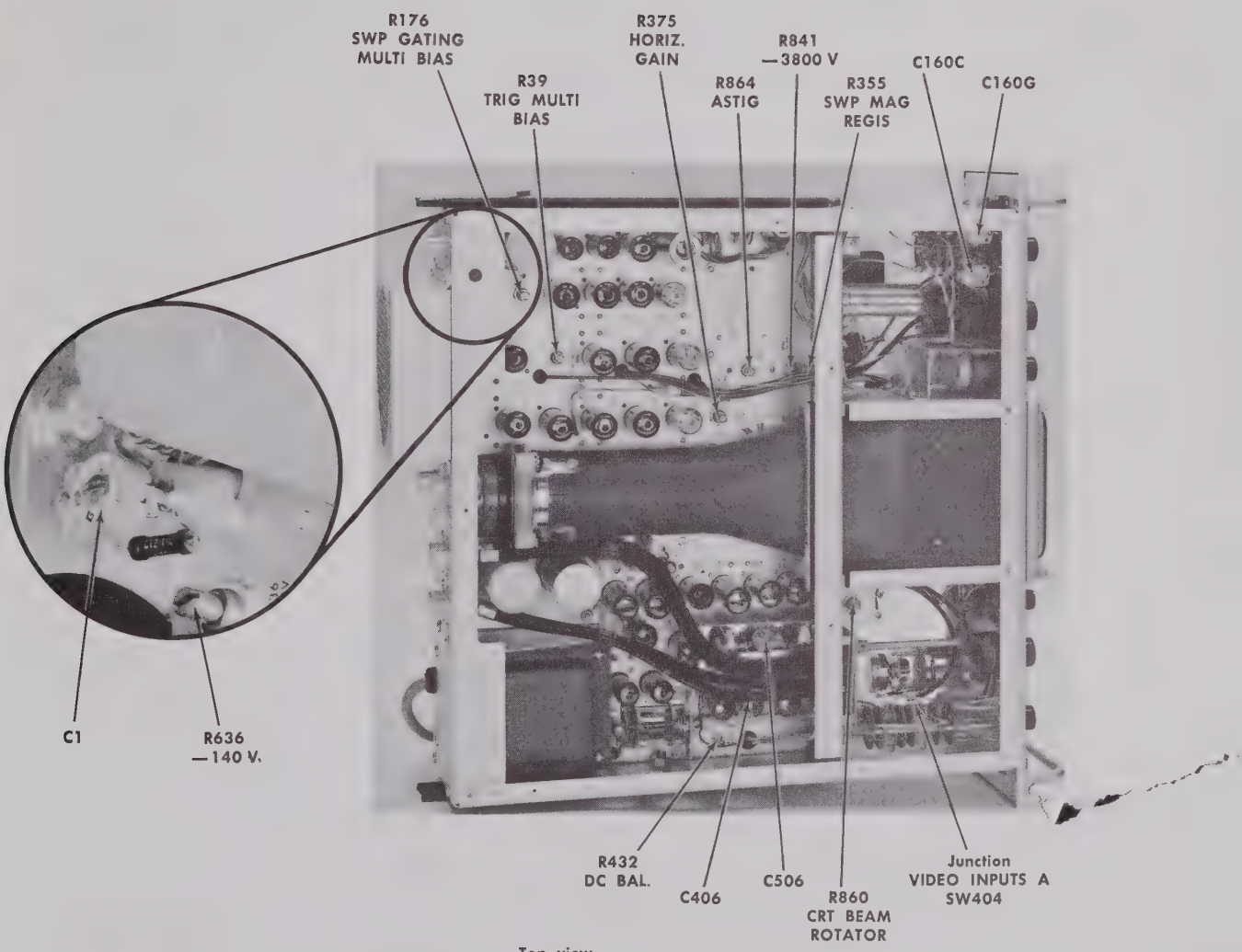
‡ SW601 ganged with R601. Furnished as a unit.
†ECF80, 7643/E80CF or 6U8A may be substituted.
†† Furnished as a unit.
††† Furnished as a unit.



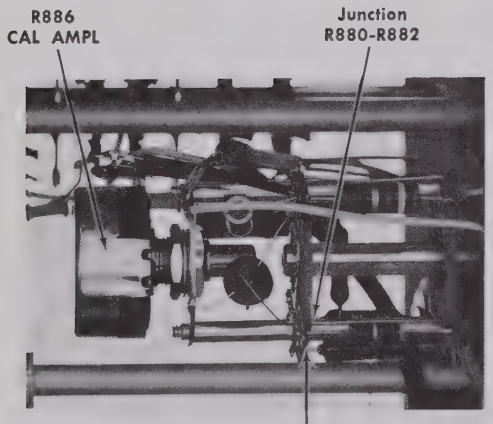
Bottom view, rear.



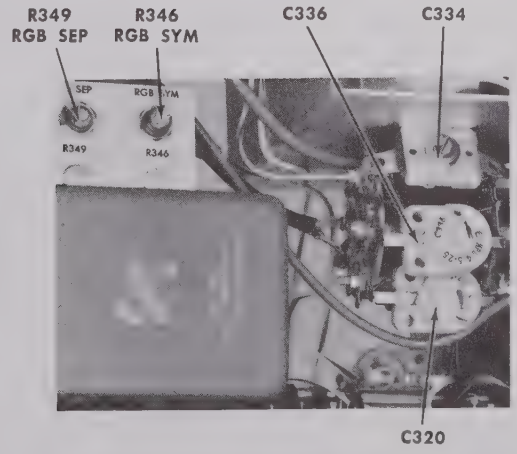
Bottom view, rear.



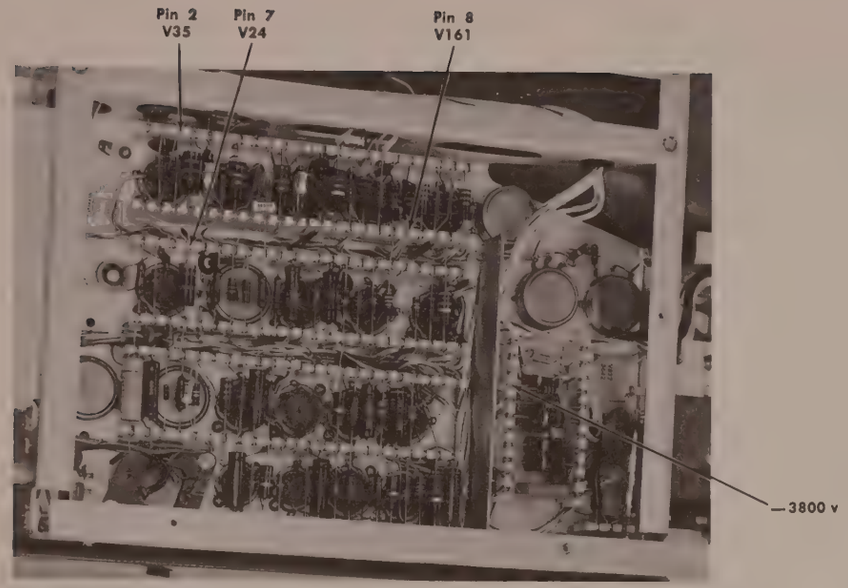
Top view.



Right side, bottom view, front.

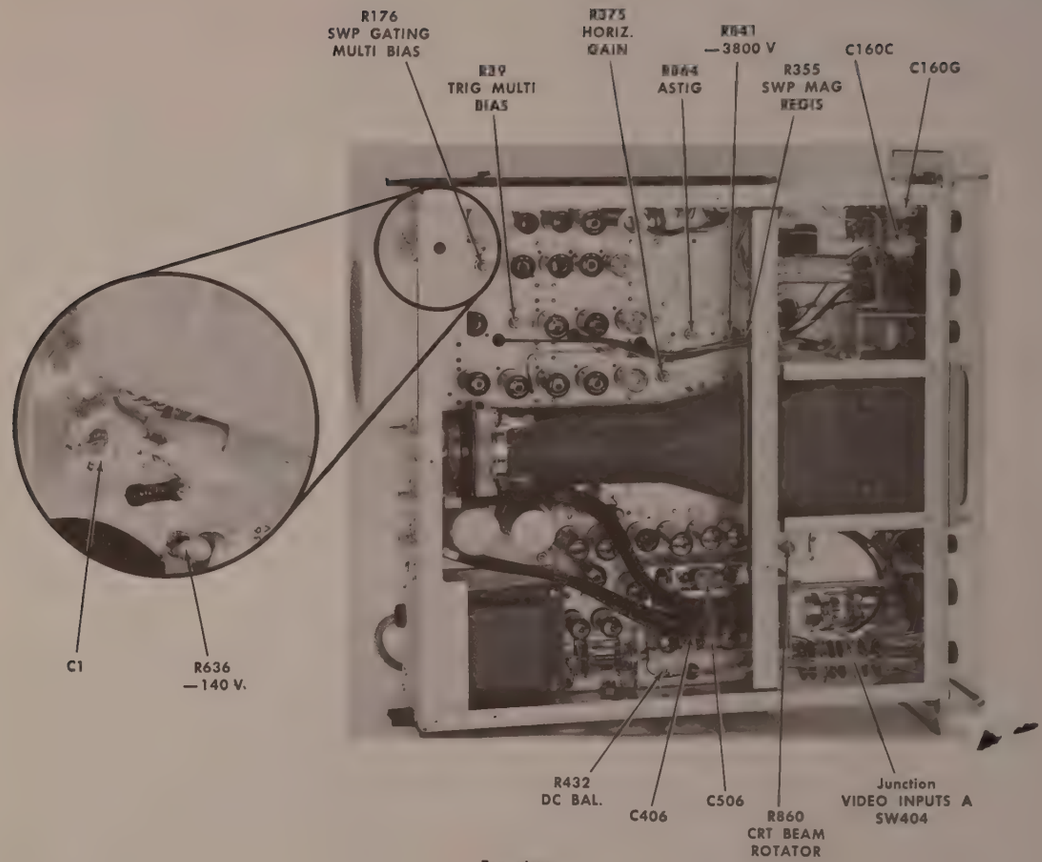


Left side, bottom view, front.

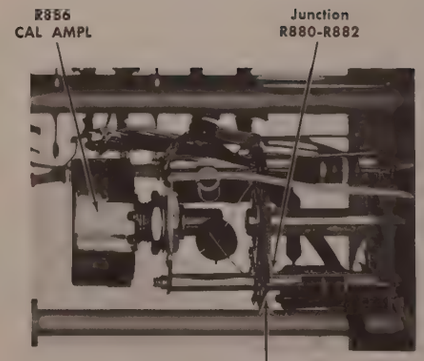


Bottom view, rear.

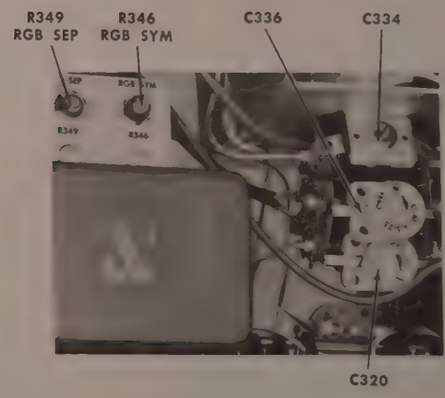
Bottom view, rear.



Top view.



Right side, bottom view, front.



Left side, bottom view, front.

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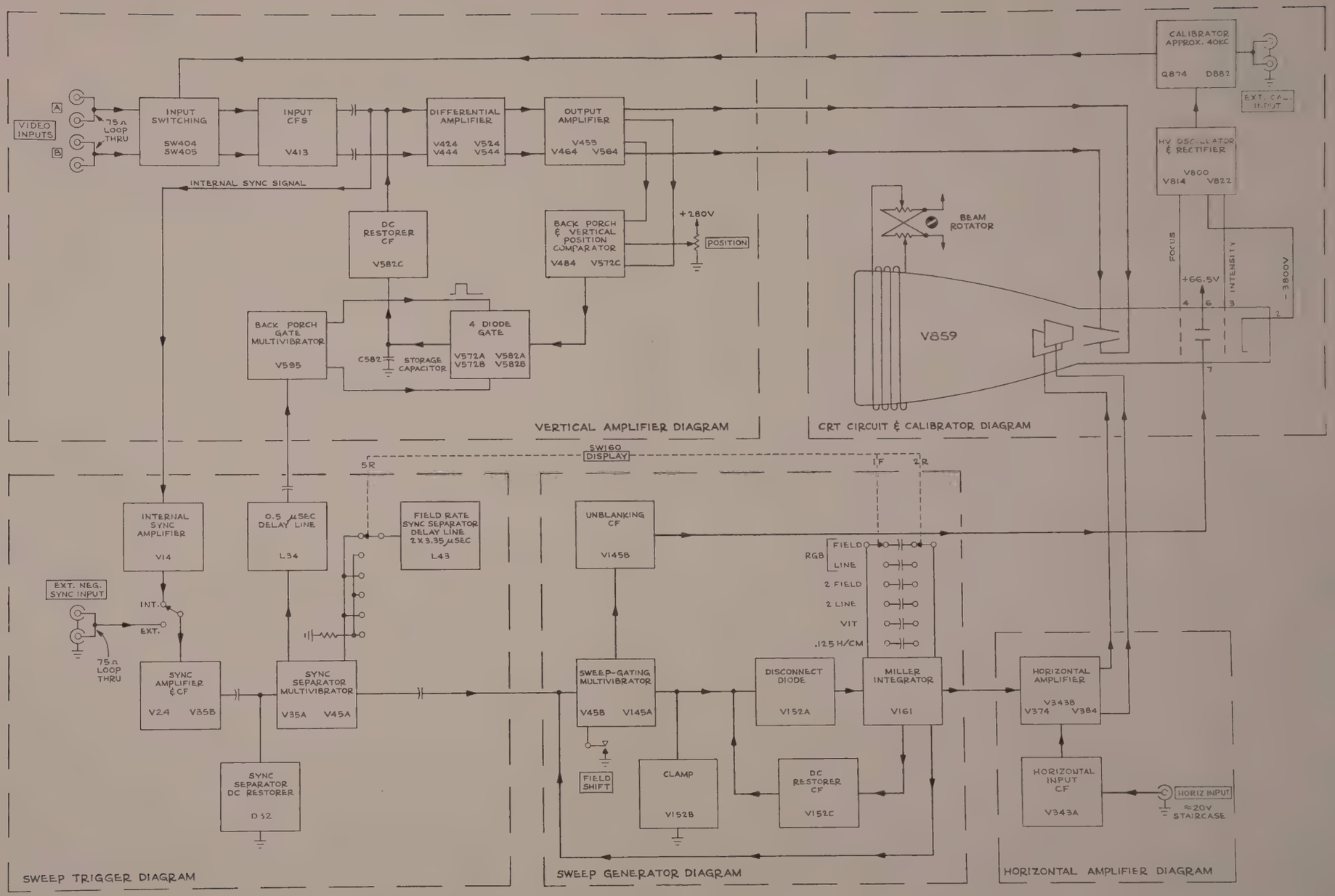
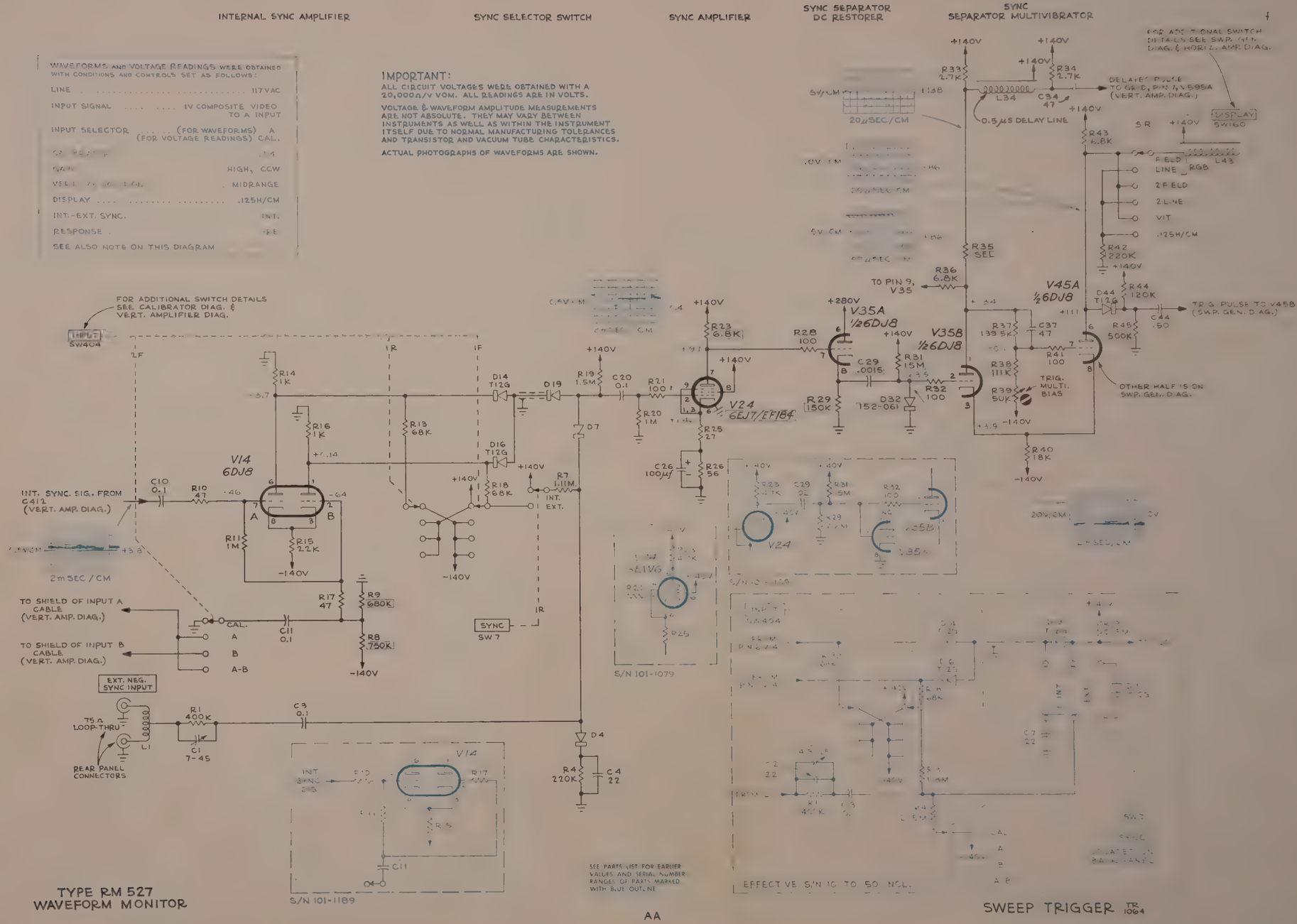


TYPE RM 527 WAVEFORM MONITOR

AA

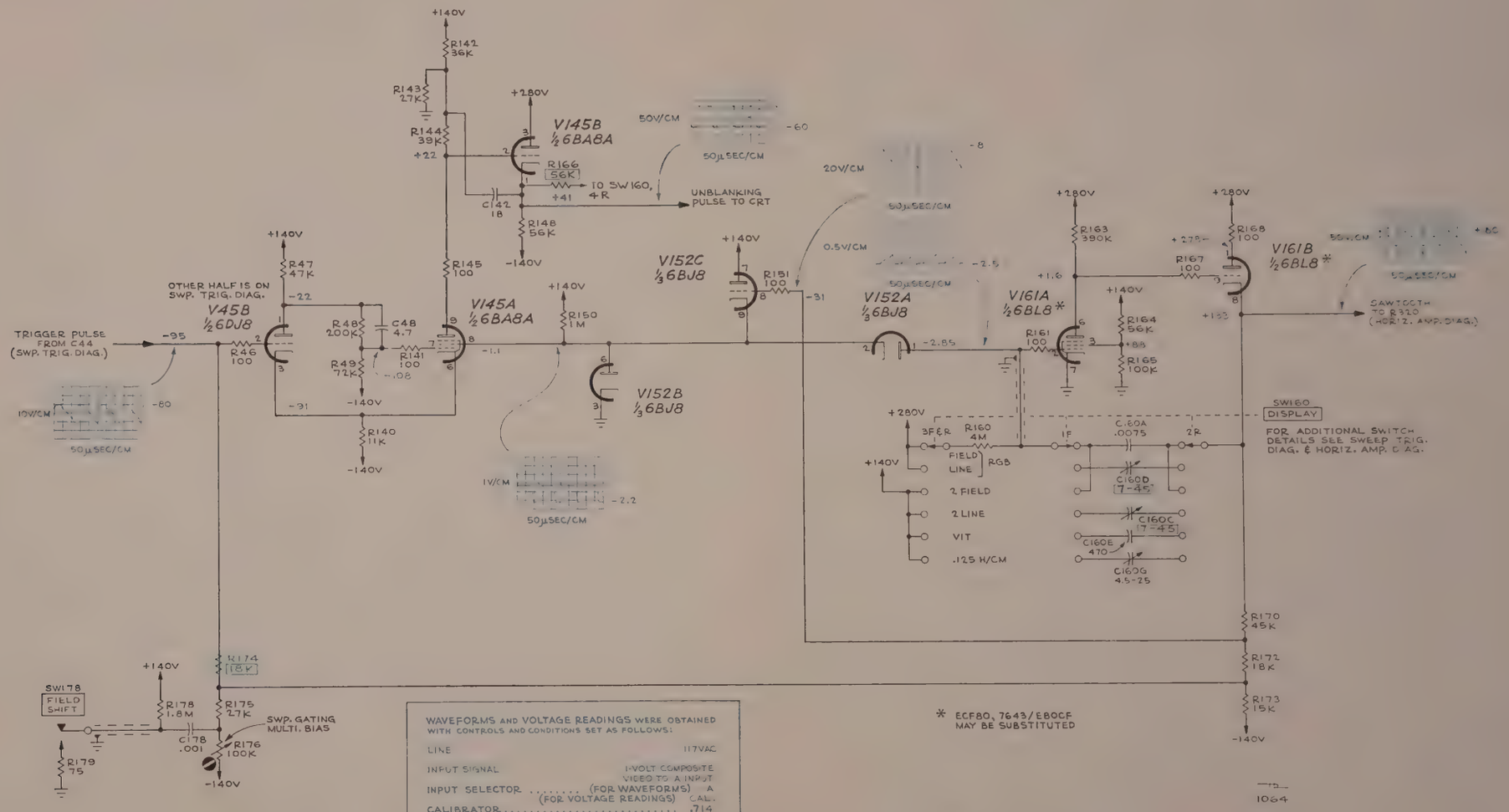
1064/1P

BLOCK DIAGRAM


INTERNAL SYNC AMPLIFIER
SYNC SELECTOR SWITCH
SYNC AMPLIFIER
SYNC SEPARATOR DC RESTORER
SYNC SEPARATOR MULTIVIBRATOR
WAVEFORMS AND VOLTAGE READINGS WERE OBTAINED WITH CONDITIONS AND CONTROLS SET AS FOLLOWS:
LINE 117VAC
INPUT SIGNAL .... 1V COMPOSITE VIDEO TO A INPUT
INPUT SELECTOR ..... (FOR WAVEFORMS) A (FOR VOLTAGE READINGS) CAL.
HIGH, CCW
MIDRANGE
DISPLAY .... .125H/CM
INT.-EXT. SYNC. INT.
SEE ALSO NOTE ON THIS DIAGRAM
IMPORTANT:
ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000Ω/V VOM. ALL READINGS ARE IN VOLTS.
VOLTAGE & WAVEFORM AMPLITUDE MEASUREMENTS ARE NOT ABSOLUTE. THEY MAY VARY BETWEEN INSTRUMENTS AS WELL AS WITHIN THE INSTRUMENT ITSELF DUE TO NORMAL MANUFACTURING TOLERANCES AND TRANSISTOR AND VACUUM TUBE CHARACTERISTICS.
ACTUAL PHOTOGRAPHS OF WAVEFORMS ARE SHOWN.
FOR ADDITIONAL SWITCH DETAILS SEE CALIBRATOR DIAG. & VERT. AMPLIFIER DIAG.
INPUT SW404
INT. SYNC. SIG. FROM C412 (VERT. AMP. DIAG.)
2m SEC / CM
TO SHIELD OF INPUT A CABLE (VERT. AMP. DIAG.)
TO SHIELD OF INPUT B CABLE (VERT. AMP. DIAG.)
CAL.
A
B
A-B
EXT. NEG. SYNC INPUT
75Ω LOOP-THRU
REAR PANEL CONNECTORS
SYNC SW 7
INT. EXT.
V14 6DJ8
V24 6EJ7/EF184
V35A ½6DJ8
V35B ½6DJ8
V45A ½6DJ8
+140V
+280V
-140V
20μSEC/CM
20μSEC CM
0.5μS DELAY LINE
DELAYED PULSE TO GR. D, PIN 1 V595A (VERT. AMP. DIAG.)
DISPLAY SW160
FIELD
LINE
RGB
2 FIELD
2 LINE
VIT
.125H/CM
TRIG. MULTI. BIAS
OTHER HALF IS ON SWP. GEN. DIAG.
TRIG PULSE TO V45B (SWP. GEN. DIAG.)
TO PIN 9, V35
S/N 101-1079
S/N 101-1189
EFFECTIVE S/N 10 TO 50 INCL.
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE
AA
SWEEP TRIGGER TR 1064

TYPE RM 527
WAVEFORM MONITOR

SWEEP-GATING MULTIVIBRATOR UNBLANKING CF CLAMP DC RESTORER CF DISCONNECT DIODE MILLER INTEGRATOR



WAVEFORMS AND VOLTAGE READINGS WERE OBTAINED WITH CONTROLS AND CONDITIONS SET AS FOLLOWS:

LINE	117VAC
INPUT SIGNAL	1-VOLT COMPOSITE VIDEO TO A INPUT
INPUT SELECTOR ..... (FOR WAVEFORMS)	A
(FOR VOLTAGE READINGS)	CAL.
CALIBRATOR	.714
RESPONSE	IRE
GAIN	HIGH, CCW
VERTICAL POSITION	MIDRANGE
INT.-EXT. SYNC.	INT.
DISPLAY	.125H/CM

SEE ALSO NOTE ON SWEEP TRIGGER DIAGRAM.

* ECF80, 7643/E80CF MAY BE SUBSTITUTED

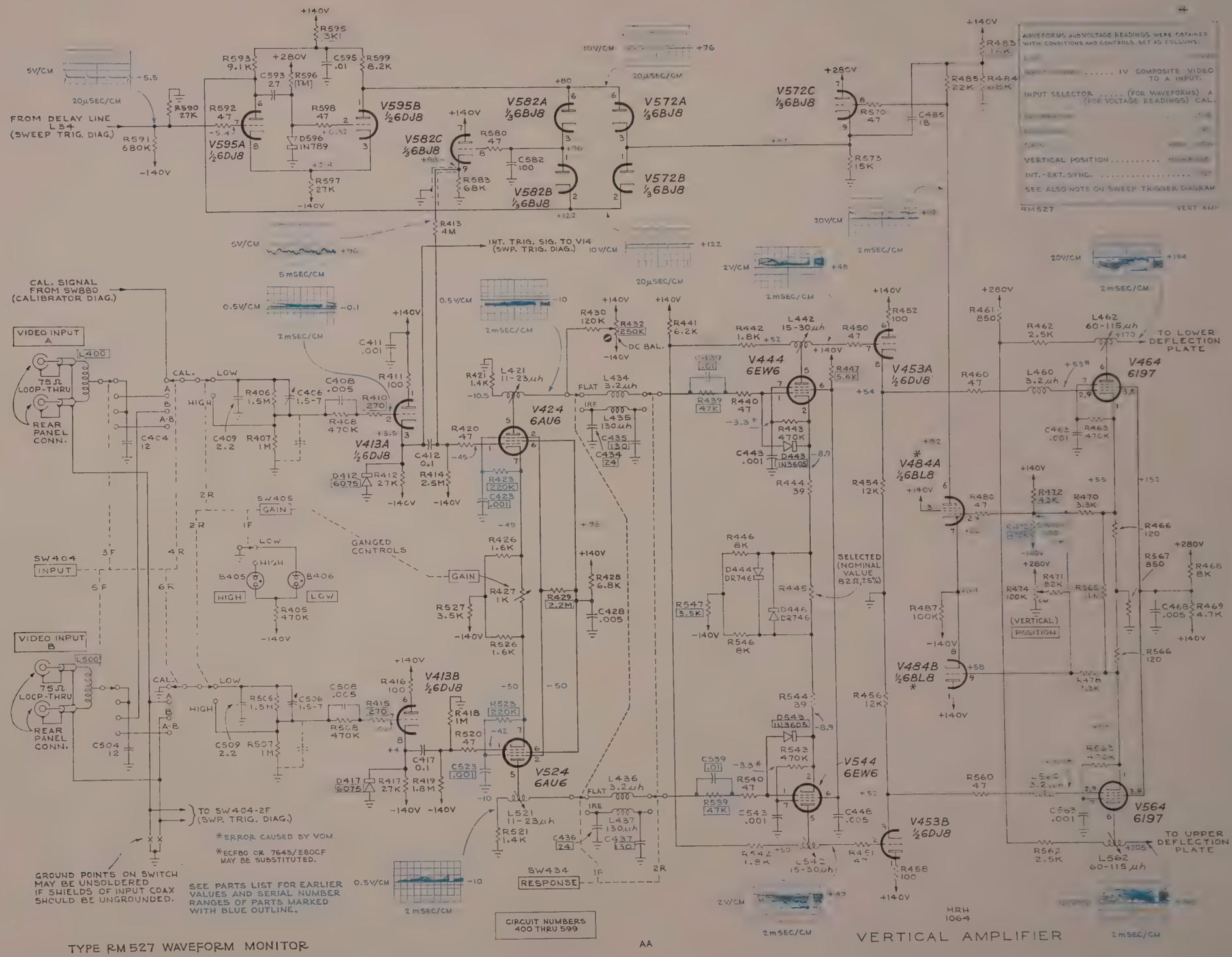
CIRCUIT NUMBERS 140 THRU 179

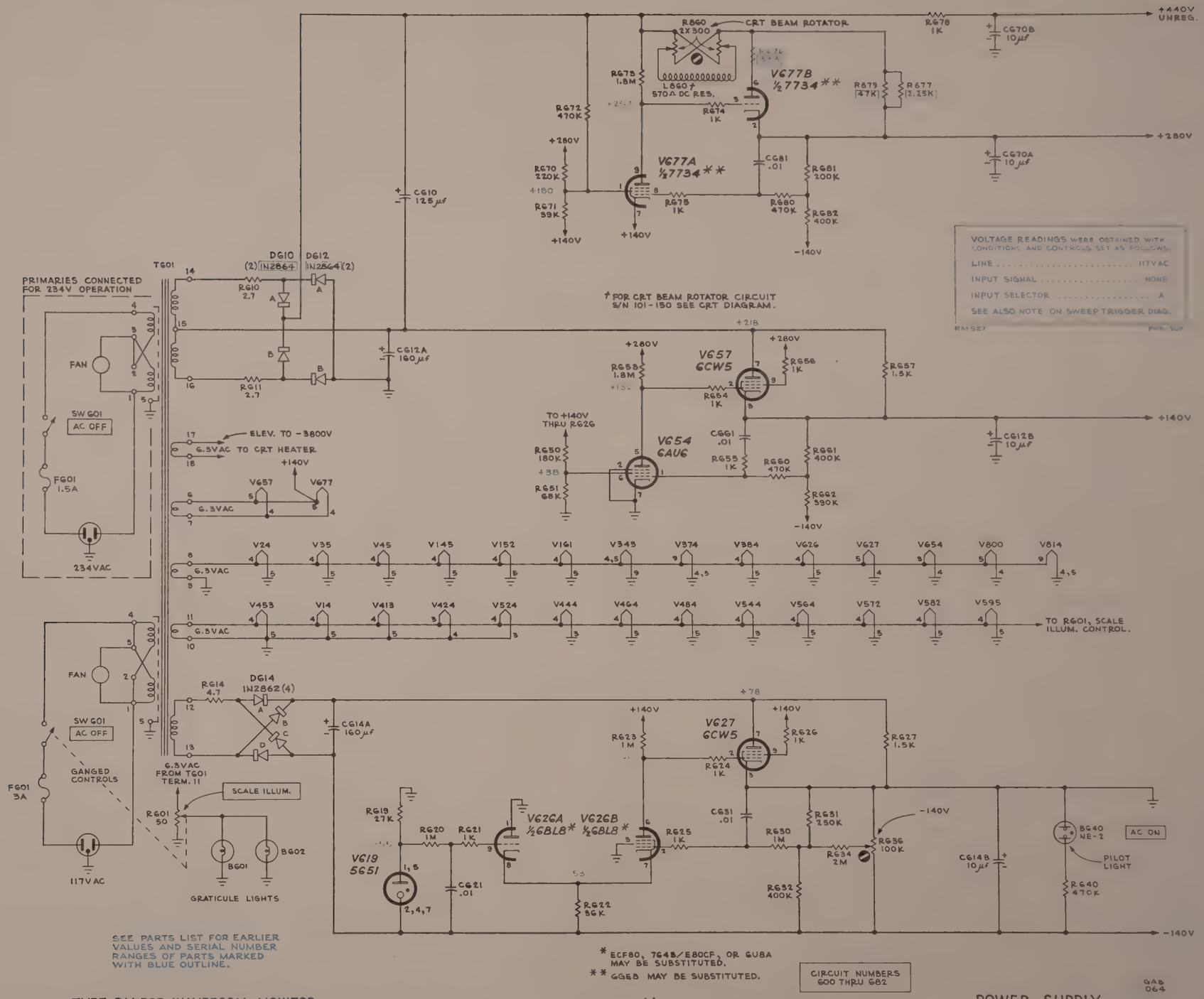
ALSO: V45B, C48, R46, R47, R48, R49

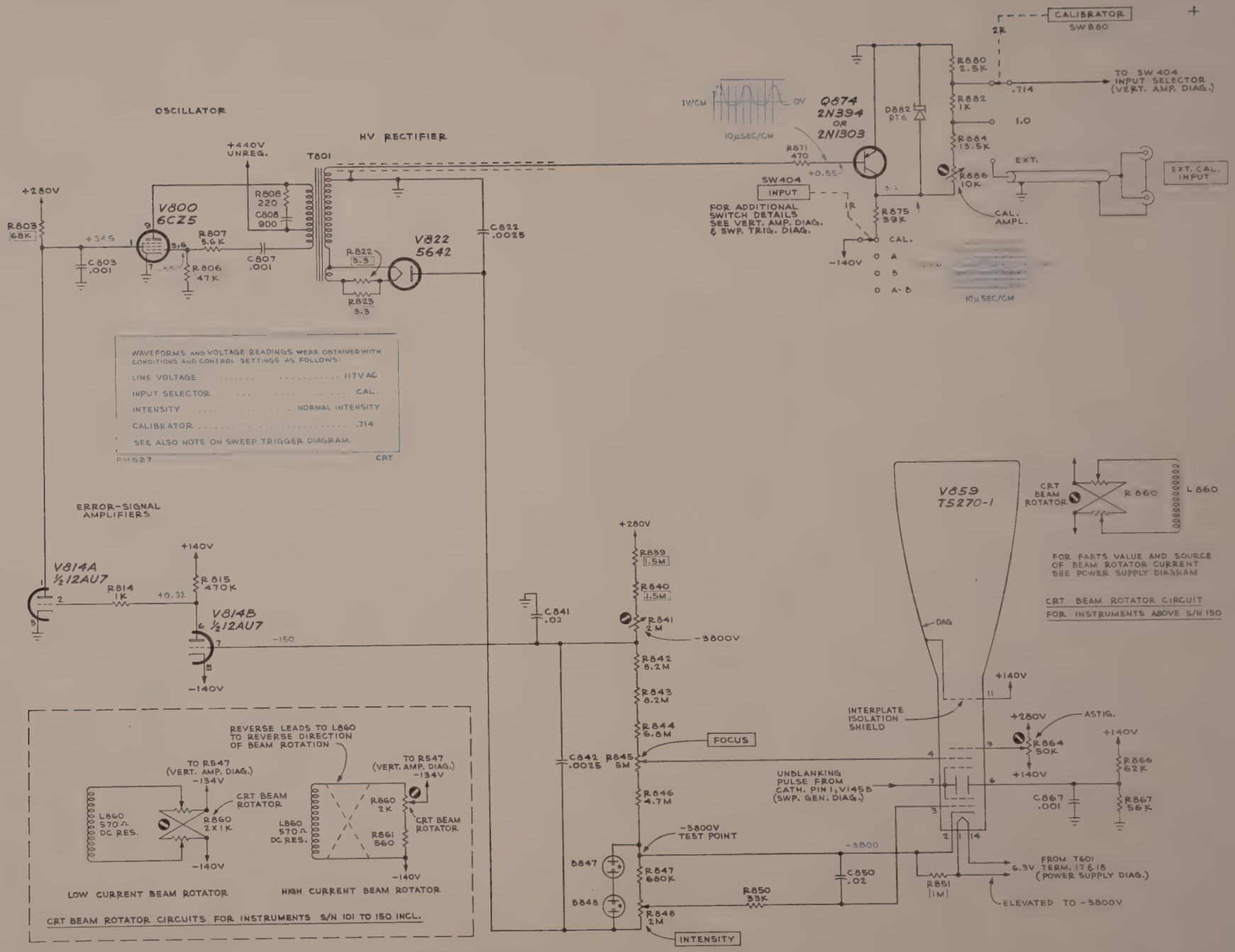
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE.

1064

TYPE RM 527 WAVEFORM MONITOR AA SWEEP GENERATOR


WAVEFORMS AND VOLTAGE READINGS WERE OBTAINED WITH CONDITIONS AND CONTROLS SET AS FOLLOWS:
..... 1V COMPOSITE VIDEO TO A INPUT.
INPUT SELECTOR ..... (FOR WAVEFORMS) A (FOR VOLTAGE READINGS) CAL.
VERTICAL POSITION .....
INT.-EXT. SYNC. .....
SEE ALSO NOTE ON SWEEP TRIGGER DIAGRAM
RM527 VERT AMP
FROM DELAY LINE L34 (SWEEP TRIG. DIAG.)
INT. TRIG. SIG. TO V14 (SWP. TRIG. DIAG.)
CAL. SIGNAL FROM SW880 (CALIBRATOR DIAG.)
VIDEO INPUT A
VIDEO INPUT B
75Ω LOOP-THRU
REAR PANEL CONN.
SW404 INPUT
SW405 GAIN
GANGED CONTROLS
SW434 RESPONSE
V595A ½6DJ8
V595B ½6DJ8
V582C ½6BJ8
V582A ½6BJ8
V582B ½6BJ8
V572C ½6BJ8
V572A ½6BJ8
V572B ½6BJ8
V413A ½6DJ8
V413B ½6DJ8
V424 6AU6
V524 6AU6
V444 6EW6
V544 6EW6
V453A ½6DJ8
V453B ½6DJ8
V484A ½6BL8
V484B ½6BL8
V464 6197
V564 6197
TO LOWER DEFLECTION PLATE
TO UPPER DEFLECTION PLATE
TO SW404-2F (SWP. TRIG. DIAG.)
*ERROR CAUSED BY VOM
*ECF80 OR 7643/E80CF MAY BE SUBSTITUTED.
GROUND POINTS ON SWITCH MAY BE UNSOLDERED IF SHIELDS OF INPUT COAX SHOULD BE UNGROUNDED.
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
CIRCUIT NUMBERS 400 THRU 599
SELECTED (NOMINAL VALUE 82Ω, ±5%)
(VERTICAL) POSITION
DC BAL.
TYPE RM 527 WAVEFORM MONITOR
AA
MRH 1064
VERTICAL AMPLIFIER


+440V UNREG.
R660 2X300 CRT BEAM ROTATOR
R678 1K
CG70B 10µf
R675 1.8M
L660† 570Ω DC RES.
V677B ½7734**
R679 47K
R677 2.15K
R672 470K
R674 1K
+280V
CG70A 10µf
V677A ½7734**
CG81 .01
R681 200K
R670 220K
R671 39K
R676 1K
R680 470K
R682 400K
+140V
-140V
CG10 125µf
VOLTAGE READINGS WERE OBTAINED WITH CONDITIONS AND CONTROLS SET AS FOLLOWS:
LINE 117VAC
INPUT SIGNAL ..... NONE
INPUT SELECTOR ..... A
SEE ALSO NOTE ON SWEEP TRIGGER DIAG.
RM 527 PWR. SUP
† FOR CRT BEAM ROTATOR CIRCUIT S/N 101-150 SEE CRT DIAGRAM.
PRIMARIES CONNECTED FOR 234V OPERATION
TG01
DG10 (2) IN2864
DG12 IN2864(2)
R610 2.7
R611 2.7
CG12A 160µf
FAN
SW G01 AC OFF
FG01 1.5A
234VAC
ELEV. TO -3800V
6.3VAC TO CRT HEATER
+140V
V657
V677
6.3VAC
+218
V657 6CW5
R658 1.8M
R656 1K
R657 1.5K
R654 1K
TO +140V THRU R626
V654 6AU6
R650 180K
R651 68K
CG61 .01
R655 1K
R660 470K
R661 400K
R662 390K
CG12B 10µf
V24 V35 V45 V145 V152 V161 V345 V374 V384 V626 V627 V654 V800 V814
V453 V14 V413 V424 V524 V444 V464 V484 V544 V564 V572 V582 V595
TO R601, SCALE ILLUM. CONTROL.
DG14 IN2862(4)
R614 4.7
CG14A 160µf
6.3VAC FROM TG01 TERM. 11
GANGED CONTROLS
FG01 3A
SCALE ILLUM.
R601 50
BG01
BG02
117VAC
GRATICULE LIGHTS
+78
V627 6CW5
R623 1M
R626 1K
R627 1.5K
R624 1K
R619 27K
R620 1M
R621 1K
V619 5651
V62GA ½6BL8*
V62GB ½6BL8*
R625 1K
CG21 .01
R622 56K
CG31 .01
R631 250K
R630 1M
R634 2M
R636 100K
R632 400K
CG14B 10µf
BG40 NE-2
AC ON
PILOT LIGHT
R640 470K
-140V
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
* ECF80, 7643/E80CF, OR 6U8A MAY BE SUBSTITUTED.
** 6GE8 MAY BE SUBSTITUTED.
CIRCUIT NUMBERS 600 THRU 682
GAB 064
TYPE RM 527 WAVEFORM MONITOR
AA
POWER SUPPLY



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

AA

CIRCUIT NUMBERS 800 THRU 886

GXD 1064

CRT CIRCUIT & CALIBRATOR

TYPE RM 527 WAVEFORM MONITOR

Adjustments

To adjust the slideout tracks for smooth operation, proceed as follows:

1. Insert the instrument into the rack as shown in Fig. 6.

2. Adjust the slideout tracks for proper spacing as shown in Fig. 7.

Maintenance

The slideout tracks require no lubrication. The special gray finish on the sliding parts is a permanent lubrication.

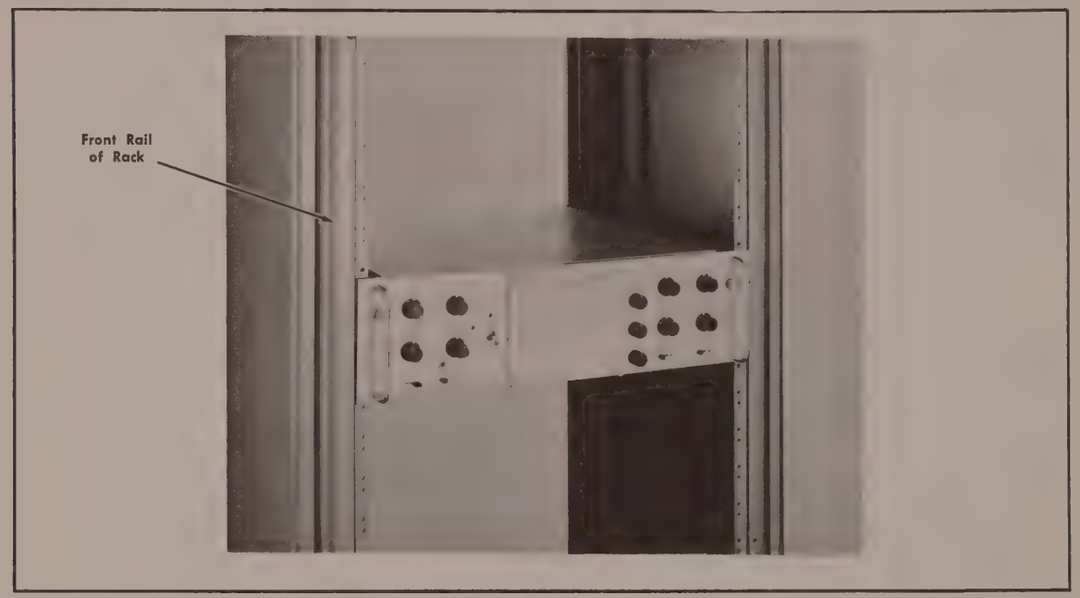


Fig. 1. The Type RM529 installed in cabinet type rack.

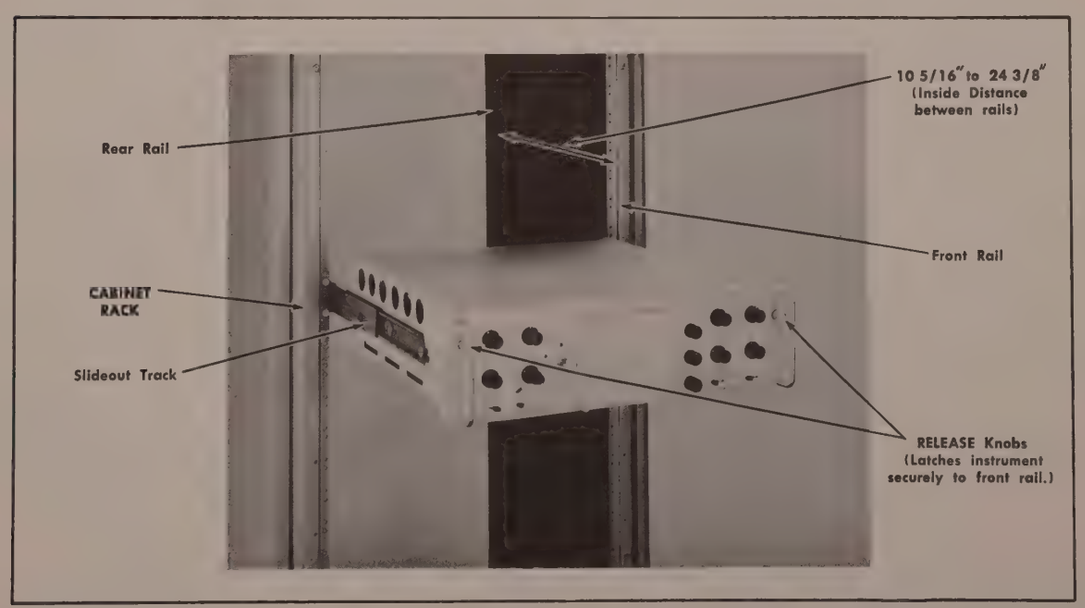


Fig. 2. The Type RM529 supported by slideout tracks mounted between front and rear cabinet rack rails.

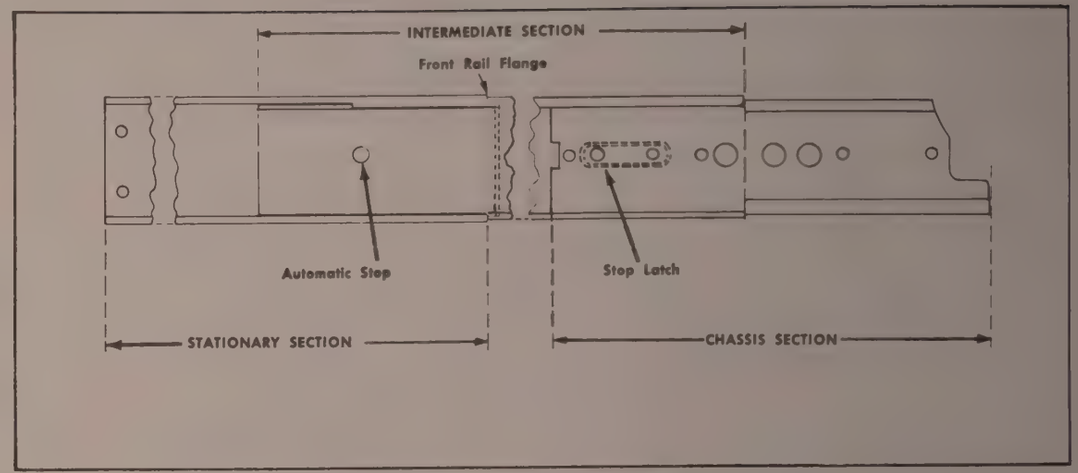


Fig. 3. Illustration showing the slideout track assembly for the right side.

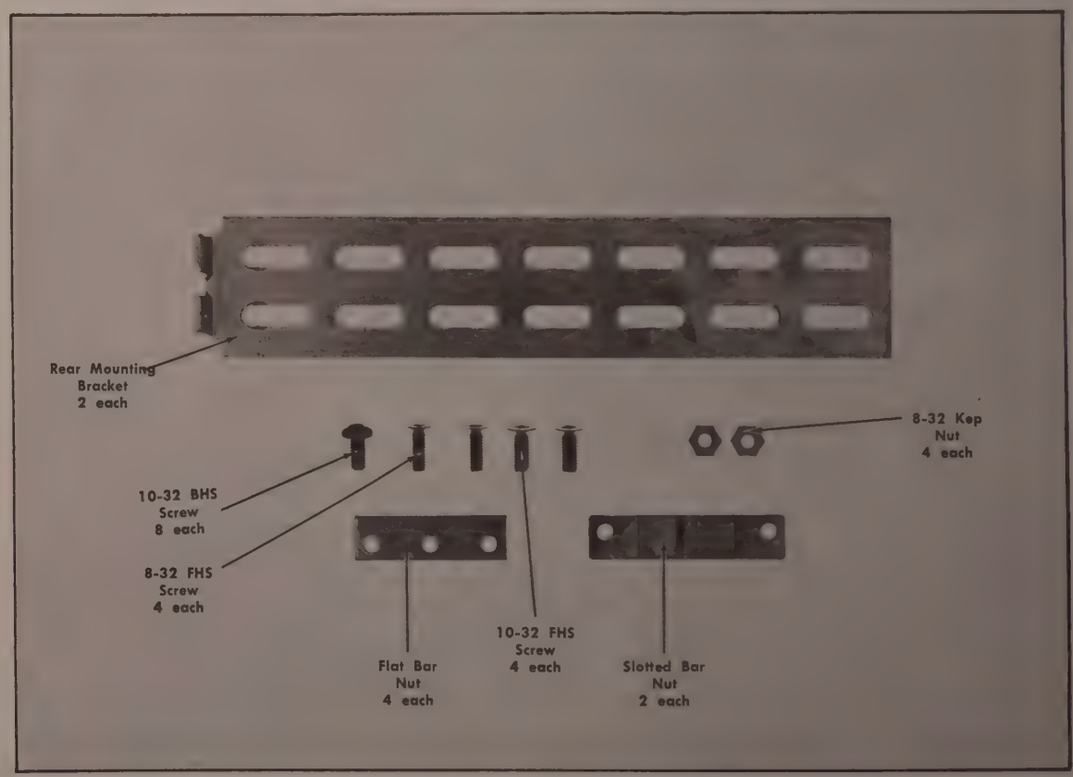


Fig. 4. Small hardware components for mounting the stationary sections to the rack rails.

INSTALLATION

RACKMOUNTING INSTRUCTIONS

Mounting Method (Figs. 1 and 2)

This instrument will fit most commercial consoles and most 19-inch wide racks whose dimensions conform to EIA specifications.

Fig. 1 shows the instrument installed in a cabinet type rack with slideout tracks. The instrument is locked into the rack by means of pawl fasteners. When the RELEASE knobs on the front panel are turned to release the instrument, the instrument can be pulled out of the rack like a drawer to its fully extended position (see Fig. 2) and then tilted up about 100°. This position permits many routine maintenance functions to be performed without completely removing the instrument from the rack. The slideout tracks easily mount to the cabinet or relay type rack front and rear vertical mounting rails if the inside distance between front and rear rails is within $10\frac{5}{16}$" to $24\frac{3}{8}$".

Some means of support (for example, make extensions for the rear mounting brackets) is needed to support the rear ends of the slideout tracks if the tracks are going to be installed in a cabinet rack whose inside dimension between front and rear rails is not the proper distance ($10\frac{5}{16}$" to $24\frac{3}{8}$").

Instrument Dimensions

The last pullout page in this section shows dimensional drawings exclusive of the power cord and cables.

Rack Dimensions

Width—A standard 19" rack may be used. The dimension or opening between the front rails of the rack must be at least $17\frac{5}{8}$" for a cabinet type rack in which the front lip of the stationary section is mounted **behind the front rail** as shown in Fig. 5b. This dimension allows room on each side of the instrument for the slideout tracks to operate so the instrument can move freely in and out of the rack.

Depth—For circulation of cooling air, allow $3\frac{3}{4}$" behind the rear of the instrument and any rear enclosure on the rack. The space allowed can be reduced slightly so long as the instrument receives at least 60 cu ft/min of air not exceeding 50° C in temperature.

Rackmounting in a Cabinet Rack (Fig. 2)

General Information

The slideout tracks for the instrument consist of two assemblies, one each for the right and left sides. Each assembly consists of three sections as illustrated in Fig. 3. The stationary section attaches to the front and rear rails of the rack with inside dimensions as shown in Fig. 2, the chassis section attaches to the instrument, and the intermediate section fits between the other two sections to allow the instrument to fully extend out of the rack.

The small hardware components included with the slideout track assemblies are shown in Fig. 4. The hardware shown in Fig. 4 is used to mount the slideout tracks to the rack rails having this compatibility; rear rail mounting holes must be drilled so as to provide the properly spaced mounting holes; front rail holes must be large enough to allow inserting a #10-32 screw; front rail holes must be located on EIA/RETMA/Western Electric or Universal spacing. Because of the above compatibility, there will be some small parts left over.

Stationary and Intermediate Sections

The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. The matched sets are marked 351-040 on the package. Use the following procedure to mount both sets. See Fig. 5 for installation details.

NOTE

If it is desired to mount the rear of the stationary slideout track sections without the bar nuts, then one hole must be drilled and tapped for a #10-32 screw in each rear rail. To locate the desired hole; 1. mount the front of the stationary slideout track section; 2. level the stationary section and mark the required hole location.

If it is desired to mount the rear of the stationary slideout track sections with the bar nuts, then two holes must be drilled in each rear rail. The desired holes may be located as above by using the stationary slideout track sections and the bar nuts.

1. If the instrument is to be mounted directly above or below another instrument in the cabinet rack, select the appropriate holes in the front rack rails for the stationary sections using Fig. 5c as a guide.

2. Mount the stationary slideout track sections to the front rack rails using Fig. 5b as a guide.

3. If the rear rack rail holes have been tapped for #10-32 machine screws, mount the left stationary section with hardware provided as shown in Fig. 5a. Using Fig. 5a as a guide, mount the right stationary section in the same manner.

4. If the rear rack rail holes are not tapped to accept #10-32 machine screws, mount the left stationary section with hardware provided as shown in Fig. 5b. Using Fig. 5b as a guide, mount the right stationary section in the same manner.

Adjustments

To adjust the slideout tracks for smooth operation, proceed as follows:

1. Insert the instrument into the rack as shown in Fig. 6.

2. Adjust the slideout tracks for proper spacing as shown in Fig. 7.

Maintenance

The slideout tracks require no lubrication. The special gray finish on the sliding parts is a permanent lubrication.

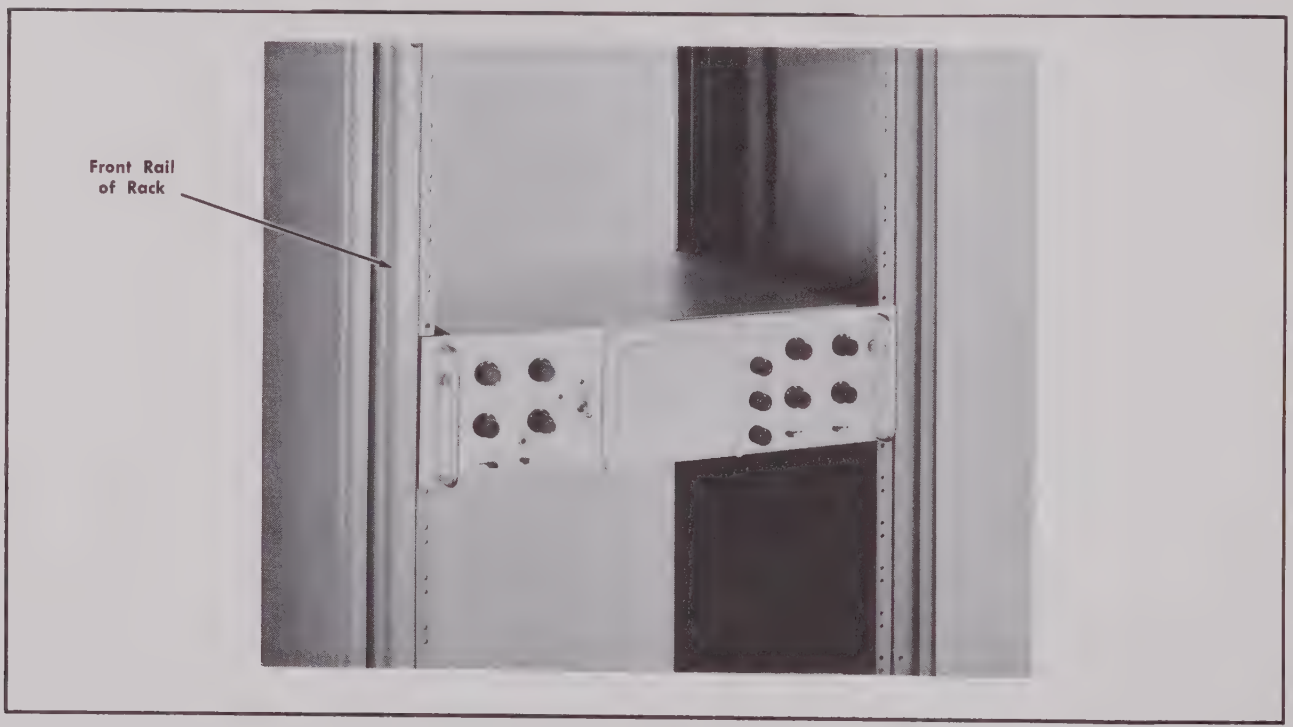


Fig. 1. The Type RM529 installed in cabinet type rack.

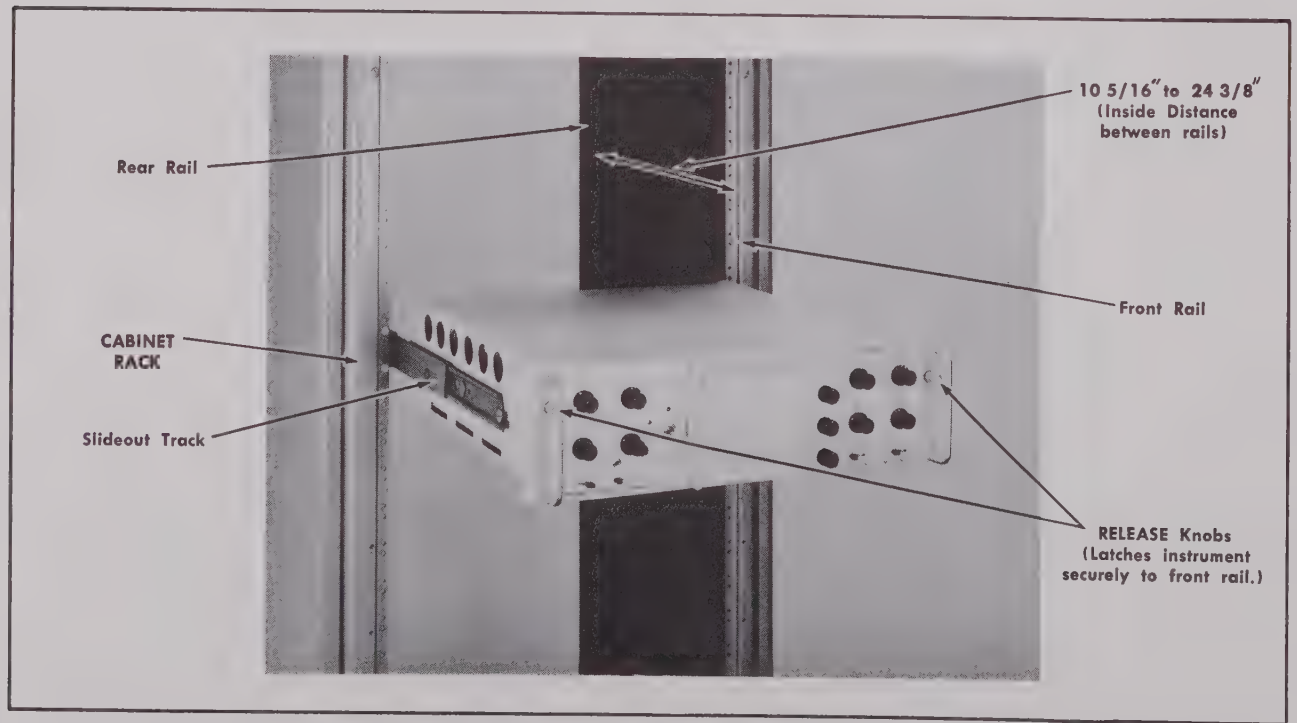


Fig. 2. The Type RM529 supported by slideout tracks mounted between front and rear cabinet rack rails.

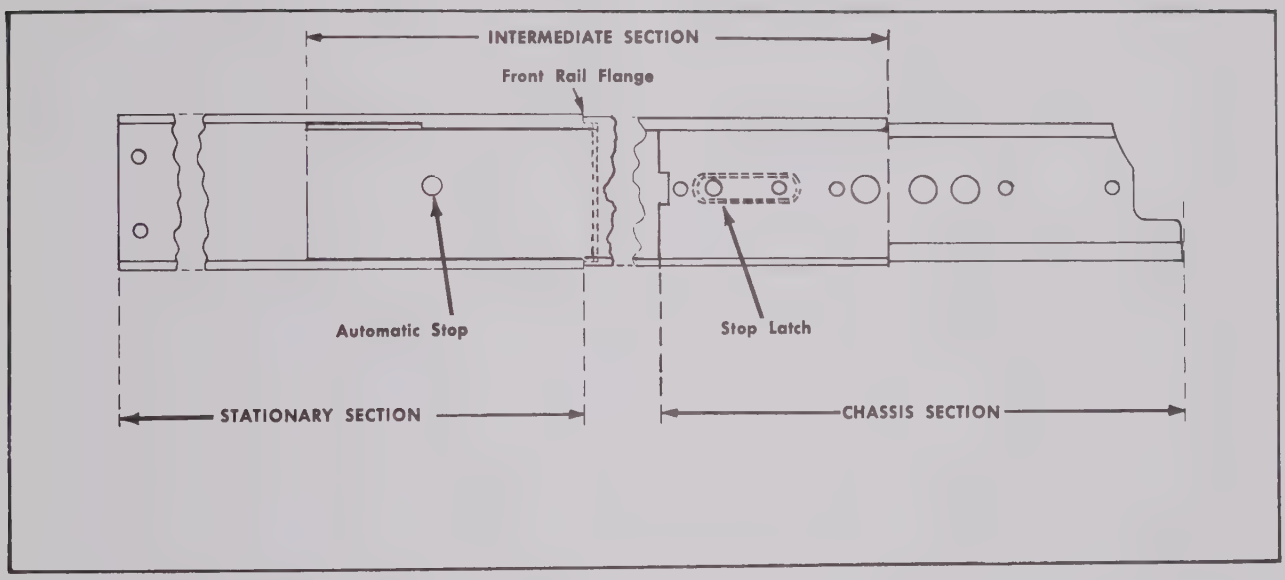


Fig. 3. Illustration showing the slideout track assembly for the right side.

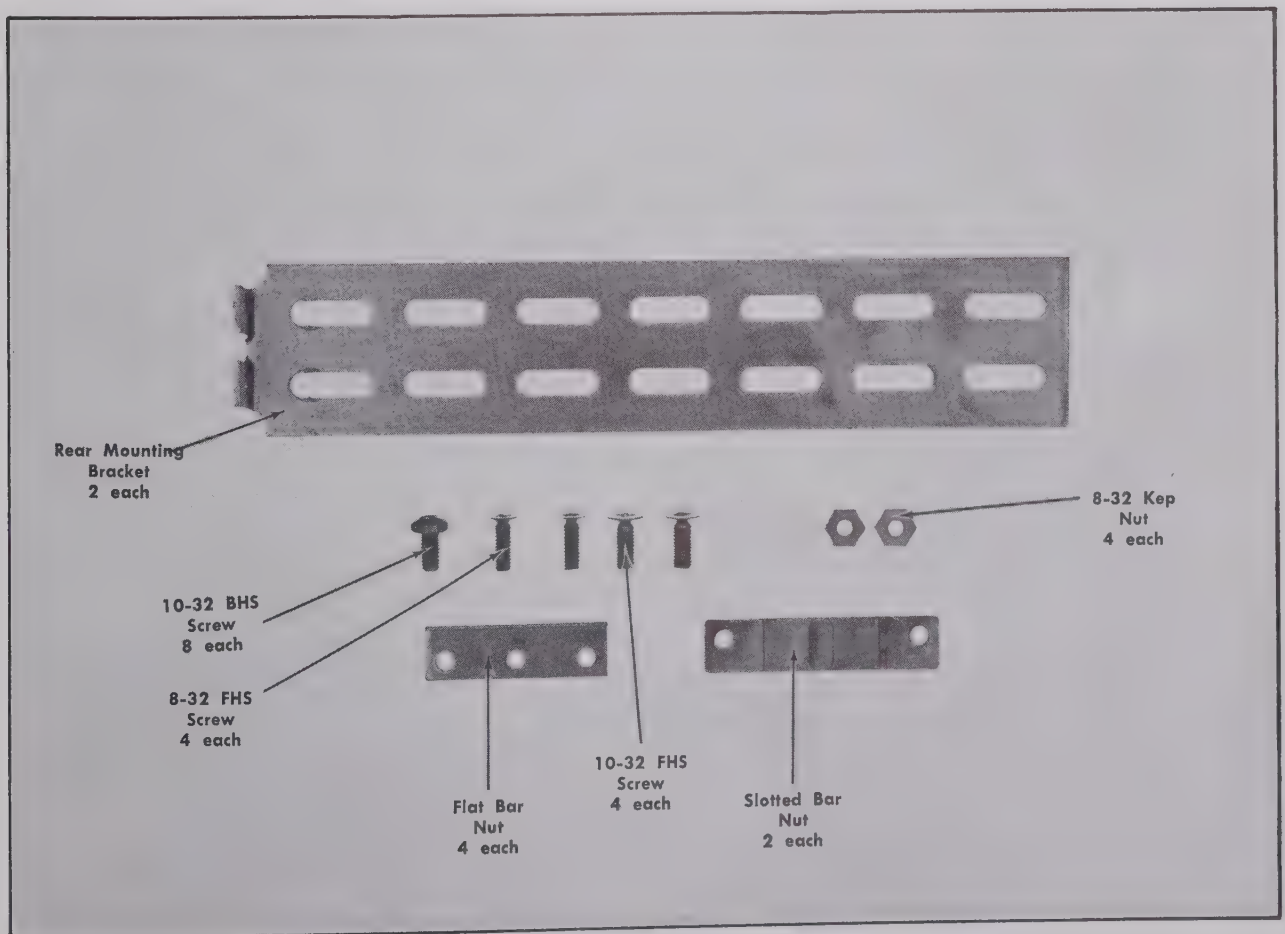
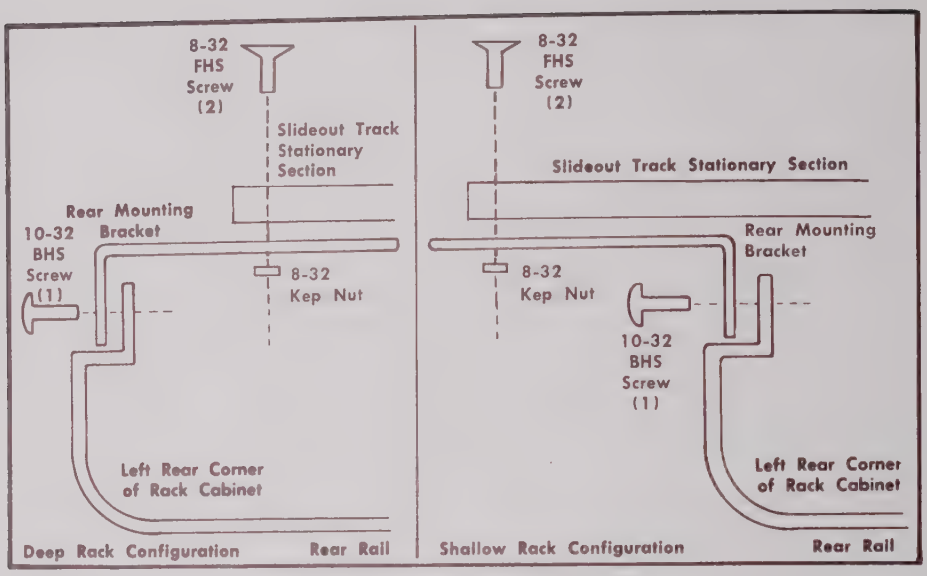
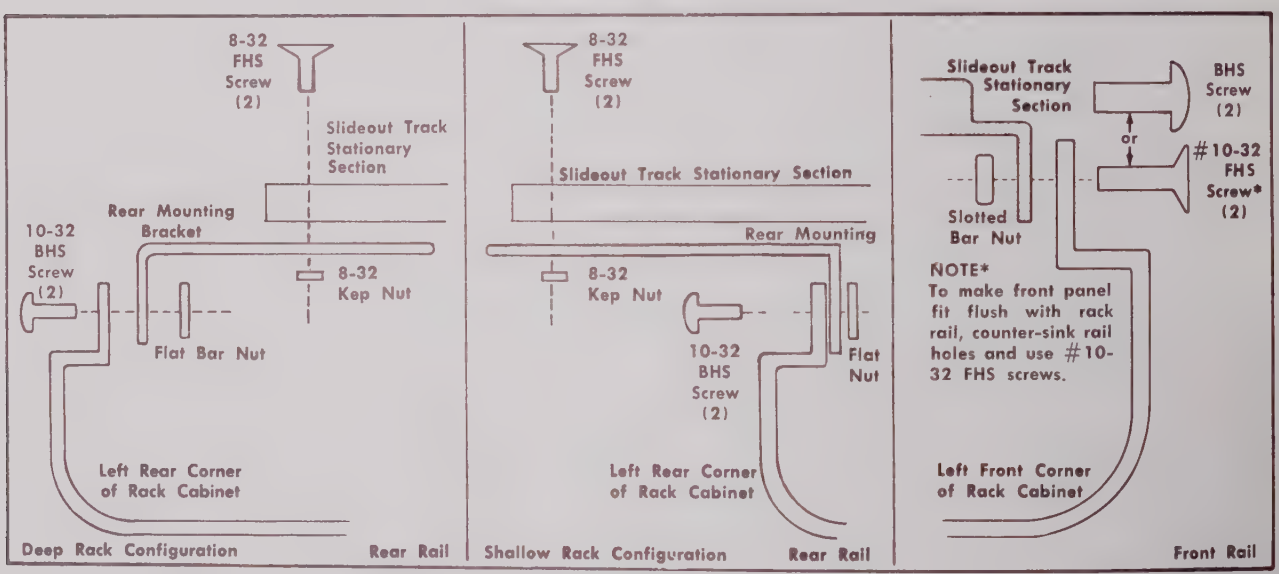

Rear Mounting Bracket 2 each
8-32 Kep Nut 4 each
10-32 BHS Screw 8 each
8-32 FHS Screw 4 each
Flat Bar Nut 4 each
10-32 FHS Screw 4 each
Slotted Bar Nut 2 each

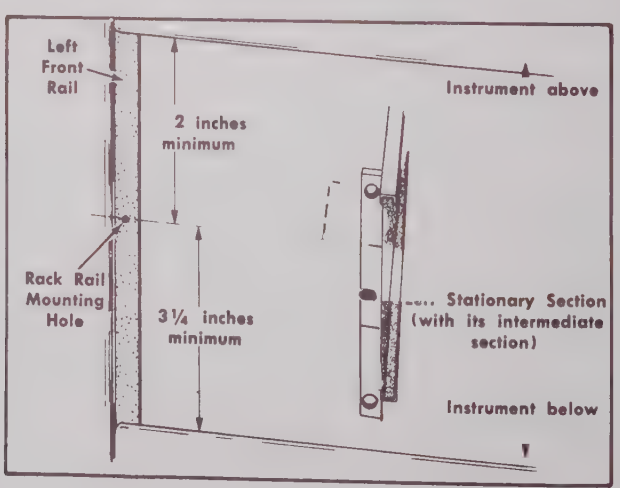
Fig. 4. Small hardware components for mounting the stationary sections to the rack rails.



(A) Rear rack rails tapped #10-32.



(B) Rack rails not tapped.

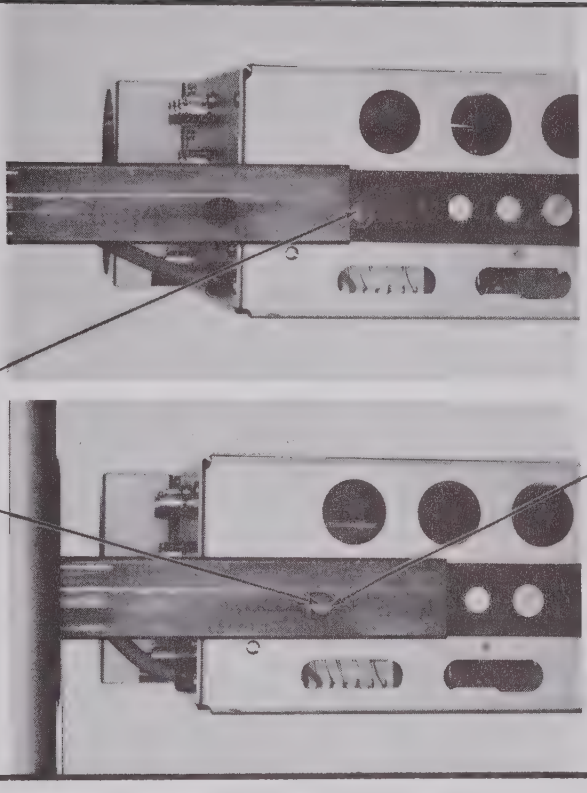


(C) Locating vertical mounting position.

Fig. 5. Mounting the left stationary section with its matched intermediate section (not shown) to rack rails.

TO INSTALL

1. Pull the slideout track intermediate sections out to the fully extended position.
2. Insert the instrument chassis sections into the intermediate sections.
3. Press stop latches and push instrument toward rack until the latches snap into their holes.
4. Again press stop latches and push instrument into rack.
5. Lock the instrument in place with the front panel RELEASE knobs.



TO REMOVE

1. Turn the RELEASE knobs to disengage the latches from the front rails.
2. Pull instrument outward until the stop latches snap into the holes.
3. Press stop latches and remove the instrument.

Fig. 6. Installing and removing the instrument.

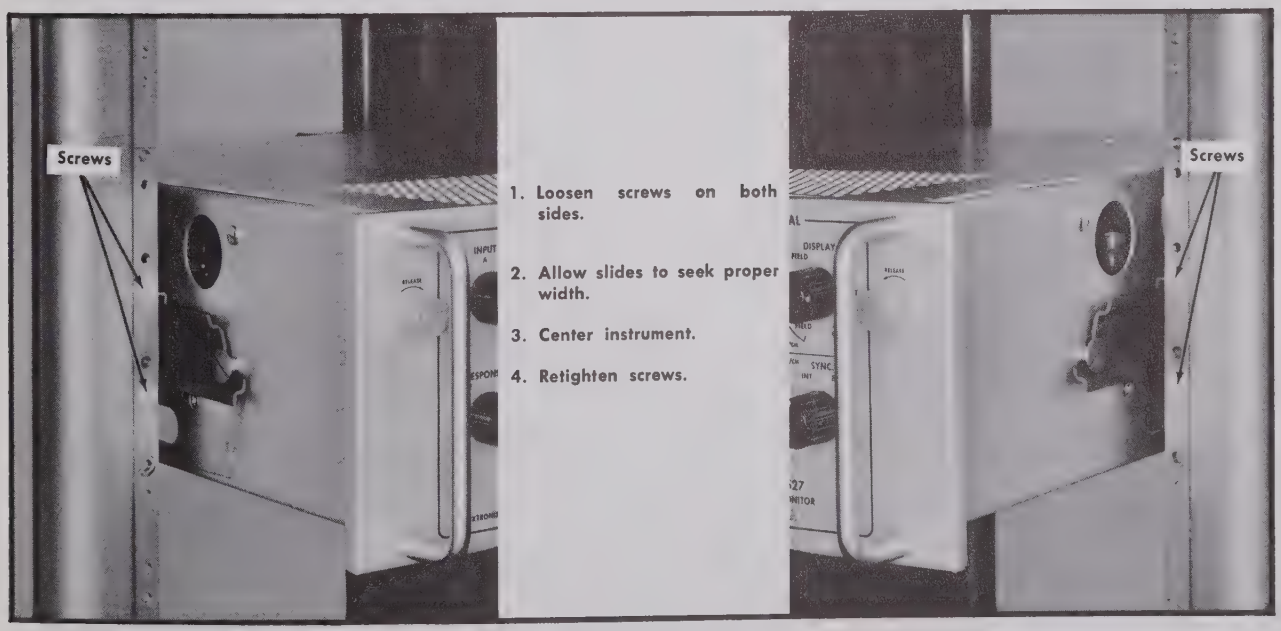
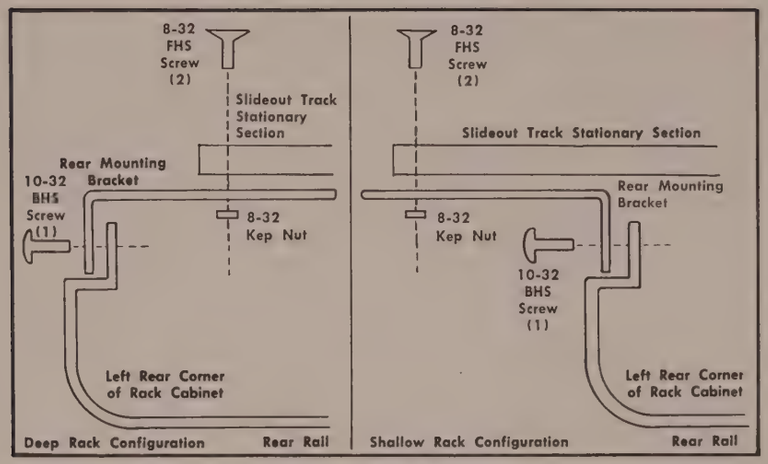
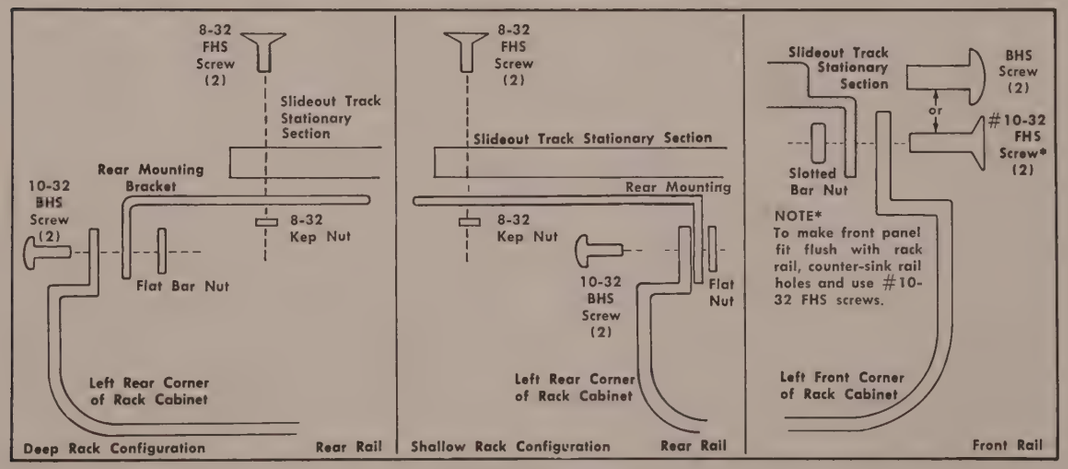


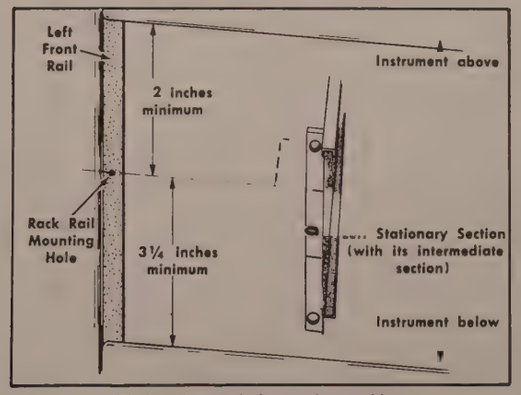
Fig. 7. Adjusting the slideout tracks for smooth sliding action.



(A) Rear rack rails tapped #10-32.



(B) Rack rails not tapped.



(C) Locating vertical mounting position.

Fig. 5. Mounting the left stationary section with its matched intermediate section (not shown) to rack rails.

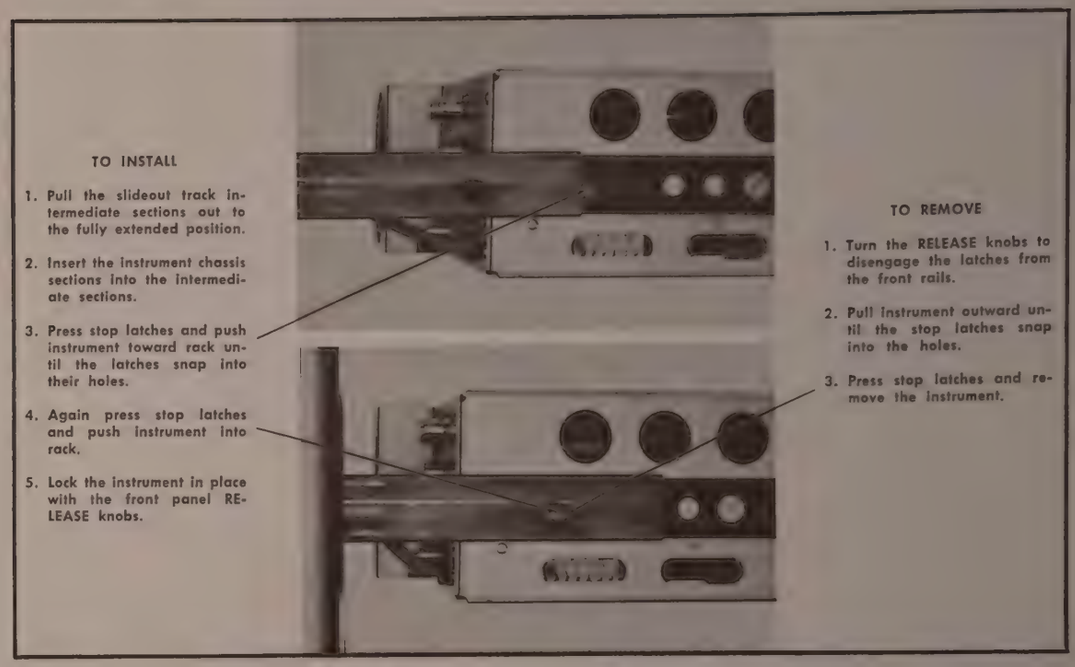

TO INSTALL
1. Pull the slideout track intermediate sections out to the fully extended position.
2. Insert the instrument chassis sections into the intermediate sections.
3. Press stop latches and push instrument toward rack until the latches snap into their holes.
4. Again press stop latches and push instrument into rack.
5. Lock the instrument in place with the front panel RELEASE knobs.
TO REMOVE
1. Turn the RELEASE knobs to disengage the latches from the front rails.
2. Pull instrument outward until the stop latches snap into the holes.
3. Press stop latches and remove the instrument.

Fig. 6. Installing and removing the instrument.

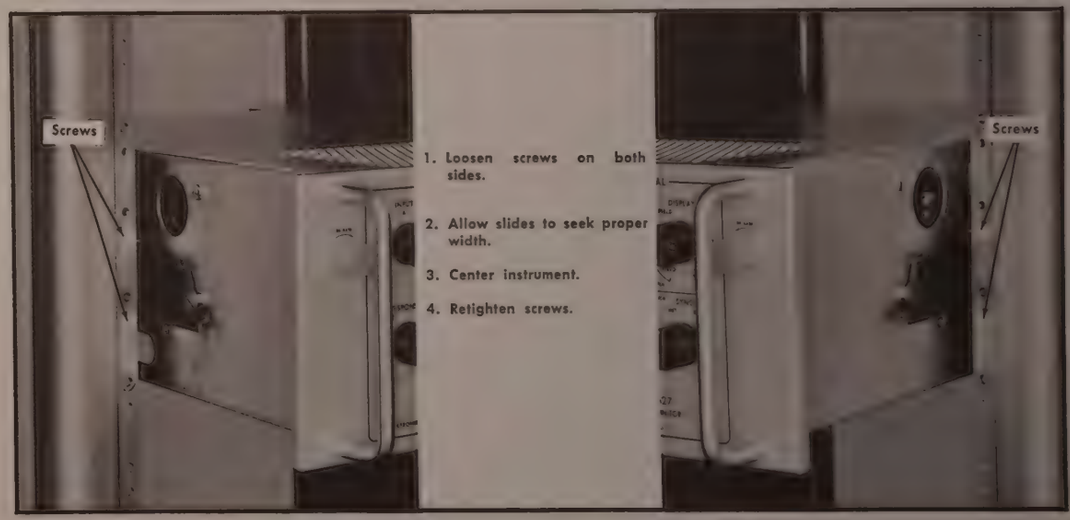
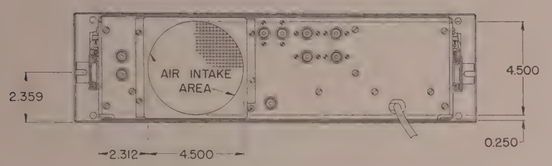
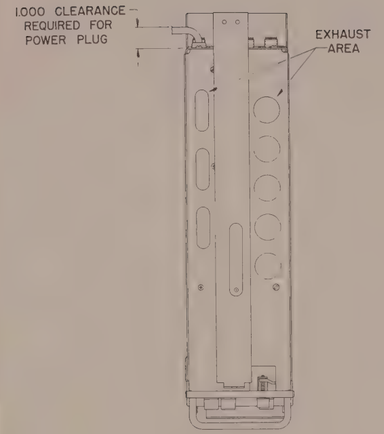
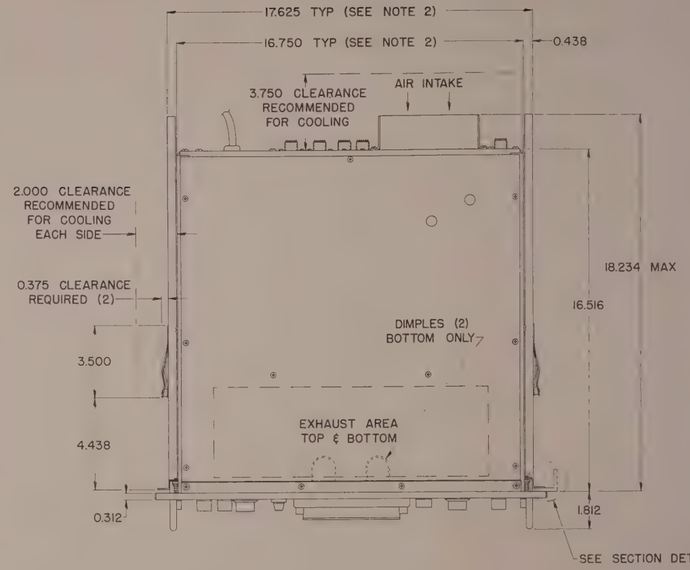


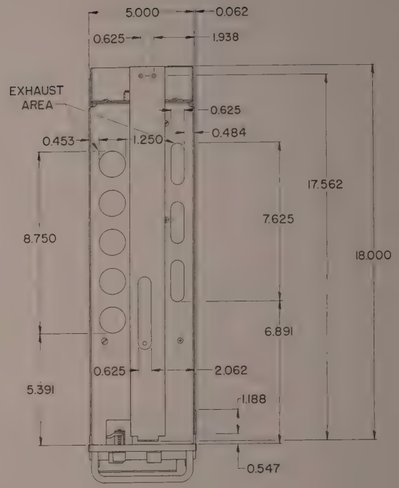
Fig. 7. Adjusting the slideout tracks for smooth sliding action.

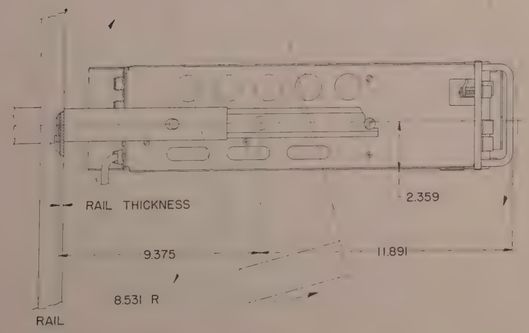


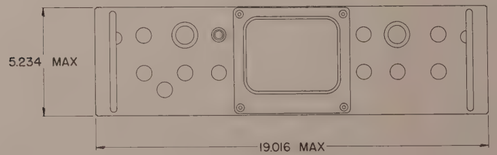
REAR VIEW

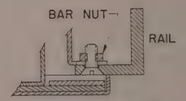












SECTION DETAIL "A"

RECOMMENDED MOUNTING

NOTES:
1. ALL DIMENSIONS ARE REFERENCE DIMENSIONS EXCEPT AS NOTED
2. SUBJECT TO APPROXIMATELY ±0.047 DEVIATION

TYPE RM527

A

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.